Marine Engineering

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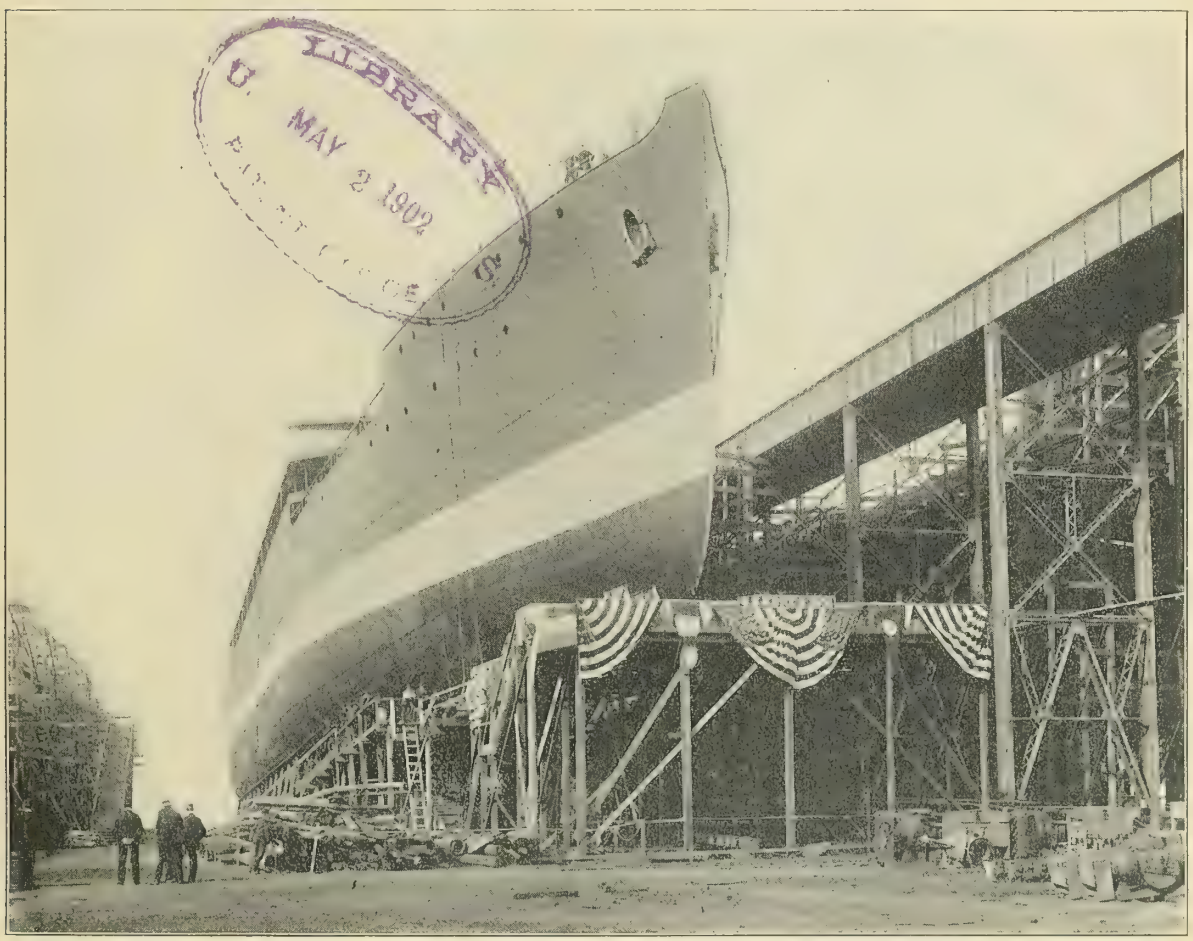
PACIFIC MAIL STEAMSHIPS KOREA AND SIBERIA, BUILT BY THE NEWPORT NEWS SHIPBUILDING AND DRY DOCK CO.

The largest ship yet built in America is just reaching completion at Newport News, Va. This is the twin-screw steamship *Korea*, one of two sister ships built by the Newport News Shipbuilding and Dry Dock Company for the Pacific Mail Steamship Company to ply between San Francisco and Japanese and Chinese ports.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STEAMSHIP KOREA READY FOR LAUNCHING FROM THE YARD OF THE NEWPORT NEWS SHIPBUILDING AND DRY DOCK COMPANY.

These ships are the first of their size to reach completion in this country, although the rapid progress of the shipbuilding industry in America is attested by the fact that these ships had not been launched before some of a trifle larger dimensions had been laid down at other places. While the *Korea* and *Siberia* do not surpass the *St. Louis* and *St. Paul*, built at Cramp's, in speed and passenger accommodation, yet they do surpass the former ships considerably in their dimensions, in freight carrying capacity and in tonnage and displacement.

The *Korea* is 550 feet long between perpendiculars, 63 feet molded beam. The principal dimensions are given in the table at the end of the article, and, of course, all particulars mentioned will apply equally to the *Siberia*, which is but a few months behind her in state of condition.

There are three complete decks, four tiers of beams, and promenade deck. The length and tonnage of deck erections are as follows: Poop, 92 feet, 347 tons; bridge, 245 feet, 1077 tons; forecastle, 72 feet, 148 tons. The gross tonnage is estimated at 11,300, and the net at 7,285 tons.

The ships are classified in the Bureau Veritas and

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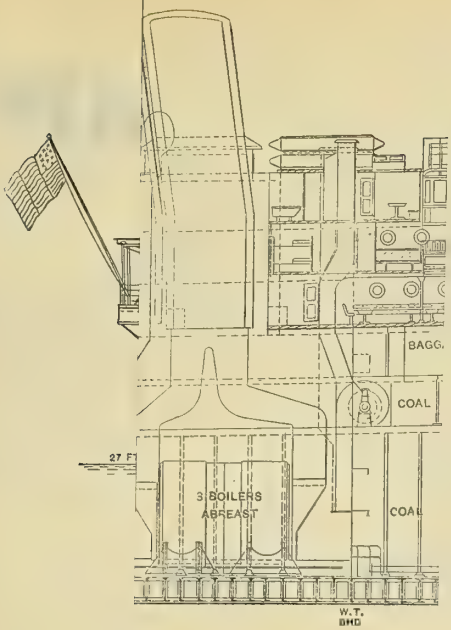
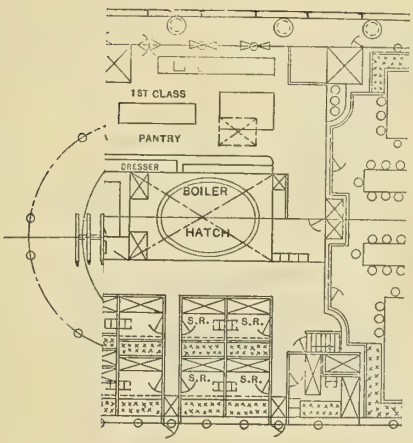
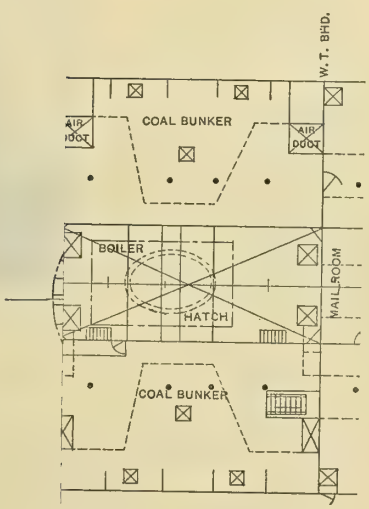
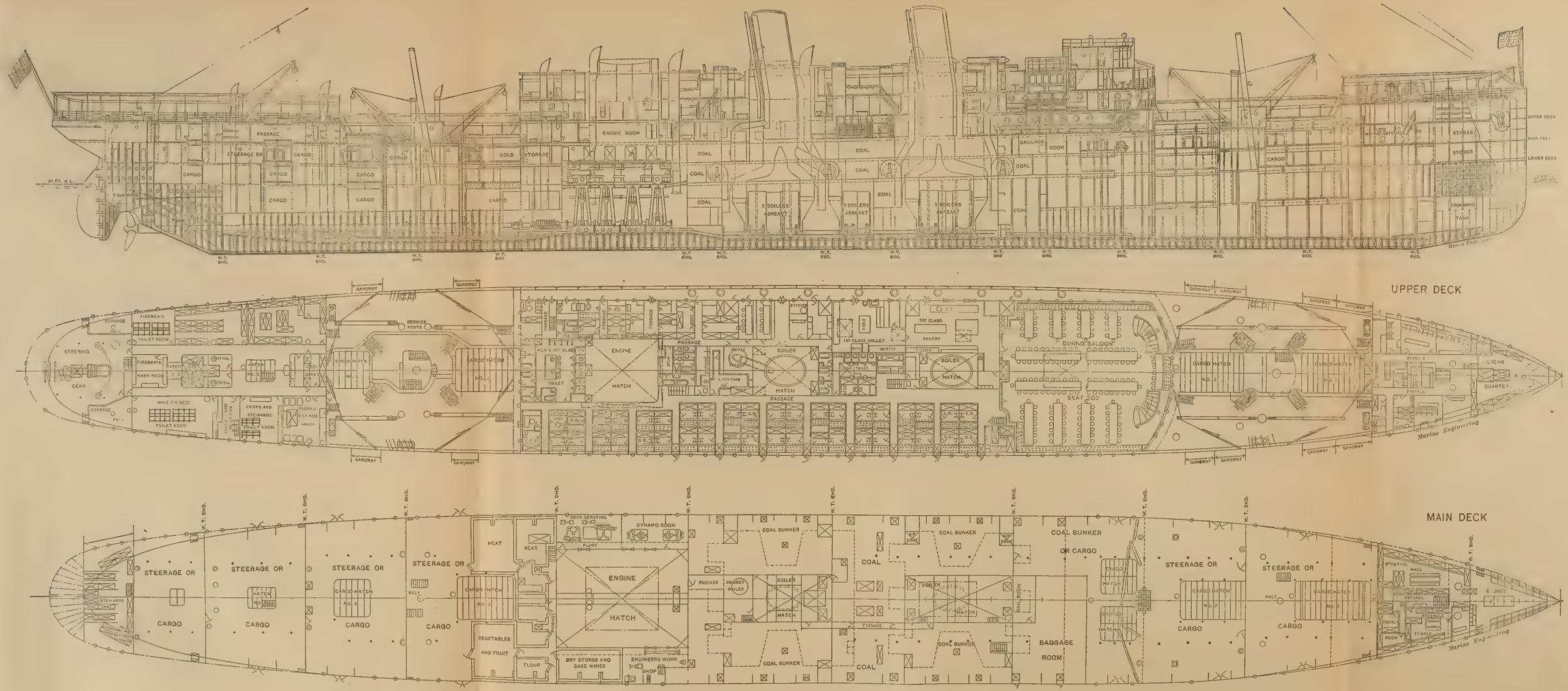






ND DRY DOCK COMPANY

SUPP



LONGITUDINAL ELEVATION AND DECK PLANS OF THE TWO SHIPS BUILT BY THE NEWPORT NEWS SHIPBUILDING AND DRY DOCK COMPANY FOR THE PACIFIC MAIL STEAMSHIP COMPANY.

the American Bureau of Shipping, and conform in all particulars, outfit, etc., to the United States Steamboat Inspection Rules.

The principal scantlings are as follows:

Inner keel, 46 1-2 inches wide, of 32-pound plate.

Outer keel, 60 inches wide, of 36-pound plate.

Rubbing strip, 13 inches wide, of 32-pound plate.

Longitudinal keel angles, 6 by 6 inch by 21.9 pounds. Main frames, 6 by 3 1-2 inch by 15.3 pound angles spaced uniformly 32 inch centers and all running to upper poop and forecastle decks. The reverse frames are 5 by 3 1-2 inch by 13.6 pound angles running to upper deck on every frame, and to forecastle deck on alternate frames. The web frames are 32 inches deep. The deck beams are 9 by 3 1-2 inch by 21.8 pound bulb angles on all main frames. Other scantlings may be seen by reference to the accompanying plan of the midship section.

The outside plating is run in fourteen strakes to upper deck, 32 pounds amidships, tapering to 28 pounds at the ends, except for the upper deck sheer strake which is 36 pounds tapering to 30 pounds with a doubling worked amidships. The next strake below is also doubled.

The stem is a steel casting, as is also the stern post. The latter carries on its forward side the steel struts for propeller bossing. The rudder is of cast steel in one piece, with a wrought stock attached by means of a palm with bolted and keyed connection. The stock is 16 1-4 inches diameter and there are 6 steel pintles 6 1-2 inches diameter with brass bushings. The entire weight of the rudder is carried, not on the pintles, but on a bearing in the upper deck.

The ships are designed to have a large cargo-carrying capacity and also a large list of passengers. At the same time the length of the sea trip makes necessary an unusually large coal capacity, and in order that the ships may when necessary sail light, an ample capacity for water ballast is provided. The water ballast is carried in a double bottom, which extends almost the entire length of the ship, from frame 16 to frame 175, a distance of 424 feet. Water ballast is also carried in the peak tanks and in a deep tank just forward of the cross coal bunker, and used either for water ballast or cargo. The capacities of these tanks in salt water are given in the table.

The double bottom extends amidships from the center vertical keel, which is water tight from frame 45 to frame 160 except at the wells, to the sixth longitudinal, which is well up the bilge.

It is 6 feet deep under the engines and 4 feet deep for the greatest length amidships. The margin varies from 40 inches deep amidships to about 32 inches aft. The flat keelson plate runs from 36 pounds to 22 pounds, and the rest of the tank top from 30 to 22 pounds, with heavier plates under the engines and boilers. The margin is 24 pounds throughout. The character of the inner bottom and its great extent forward are well shown in the accompanying photograph of the ship in frame.

The ship is divided transversely by 10 complete water tight bulkheads to the upper deck and 6 to the main deck, making 16 in all, of plate from 22 to 14 pounds, well stiffened by angle bulls 3 1-2 by 9 inches by 21.8 pounds. There is also a water tight center line bulkhead in the engine room running to the main deck, and thus placing the engines in separate water tight compartments.

The cargo and coal capacities are both large, as mentioned above, and are well illustrated, together with their relative distribution, in the following summary:

SUMMARY OF CARGO AND COAL CAPACITIES.

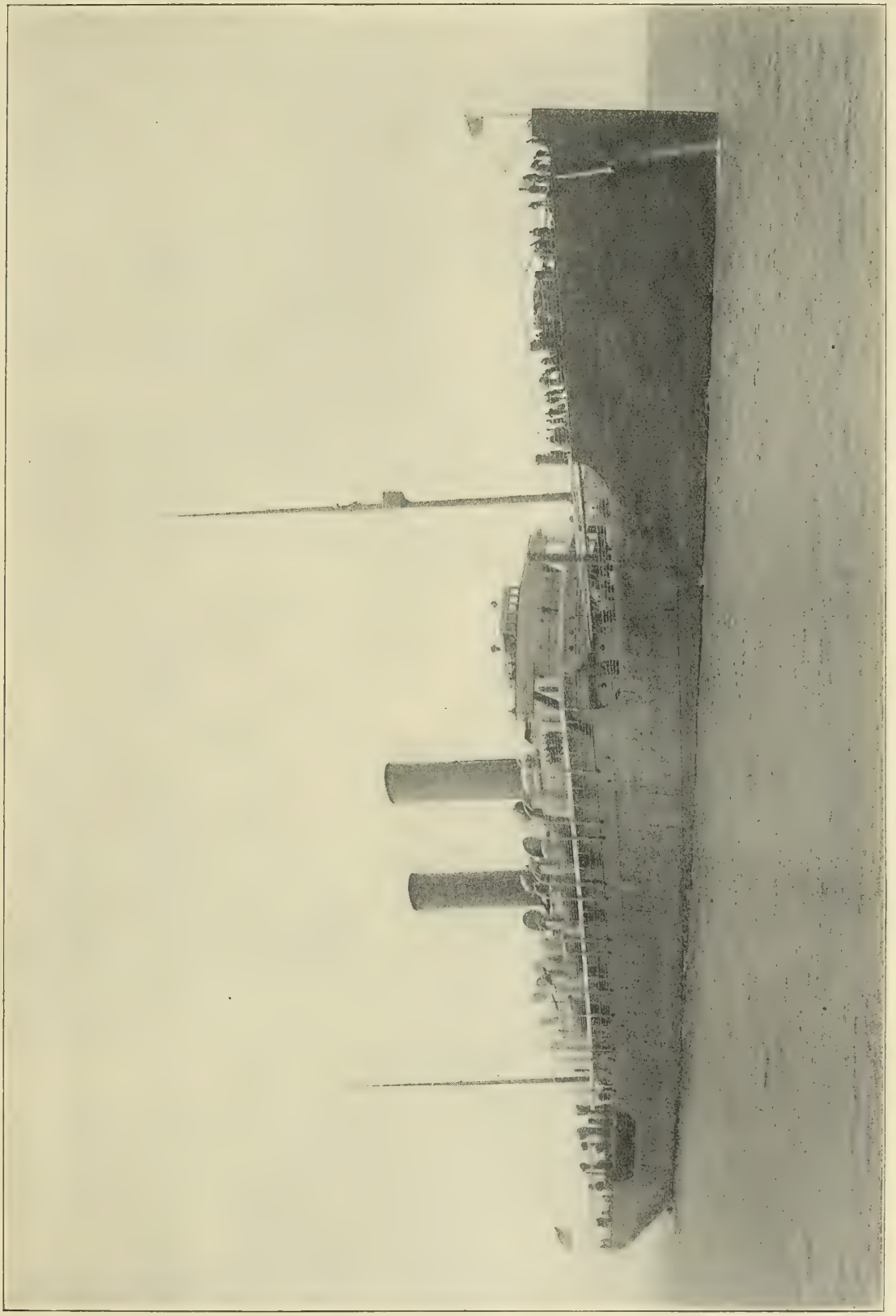
Space.	Coal, cu. ft.	Cargo, cu. ft.
Bunkers 8, 11, 12 and 13	55,321	64,055
" 1 to 7 and 9 and 10	103,320	
Cargo spaces only		397,146
Stores		13 849
Deep tank (water or cargo)		18,403
Baggage Room		7,990
Cold Storage Rooms		9,023
Total available cargo and corresponding coal	103,320 or 2,583 tons	510.466
Total available coal and corresponding cargo	158,641 or 3,966 tons	446,411

Four of the coal bunkers are arranged so as to be used for either coal or cargo; the deep tank can be used for cargo or water ballast; and the spaces fore and aft on the main deck are arranged to be used for cargo or steerage. Thus the distribution of spaces is rendered very elastic and the ship is prepared to meet almost any condition of loading.

The propelling machinery consists of two four-cylinder, vertical inverted, quadruple expansion engines with cylinders 35, 50, 70 and 100 inches diameter and 66 inches stroke. They were designed for 86 revolutions per minute and 17,500 I. H. P., and this was expected to drive the ship 18 knots per hour sustained speed.

The piston rods are 8 inches diameter for all cylinders and the connecting rods 8 1-2 inches diameter at the center and 138 inches long. The crank shaft is 19 1-2 inches diameter with a 6-inch hole. The thrust shaft is 19 inches, the line shaft 18 3-4 inches, and the propeller shaft 19 1-2 inches, all with the same sized hole. There are 14 thrust collars 31 inches diameter by 2 1-2 inches thick, with a 4-inch space between. The bed plate and bushings are of cast steel throughout. There are 8 cross girders 3 feet 8 1-2 inches deep at the center under the recess for bearing boxes, and 2 feet 11 inches deep at the side. All cylinders are provided with piston valves of 10 inches travel and the following characteristics: H. P., one 20-inch valve inside steam. First M. P., two 17-inch valves outside steam. Second M. P., two 28-inch valves inside steam. L. P., four 25-inch valves outside steam. The main steam pipe is 13 inches diameter and the exhaust to the condenser consists of two 24-inch pipes. The valve motion is the ordinary Stephenson double bar link type, with a reverse shaft 9 inches diameter, and 20 inch steam and 9-inch hydraulic reversing cylinders. The turning engine is a 7 by 7 by 5 inch double engine with the usual worm wheel drive.

Each main condenser has 11,787 square feet of cooling surface and the two auxiliary condensers 600 square feet each. There are four centrifugal main circulating



STEAMSHIP KOREA OF THE PACIFIC MAIL STEAMSHIP COMPANY.

pumps with a capacity of 6,080 gallons per minute each. The suction and discharge pipes are each 14 inches diameter and the engines are compound 11 inches and 20 inches by 10-inch stroke.

The other auxiliaries are as follows:

Main air and circulating pumps, two Blake vertical compound, 12 and 20 inches steam, 24 inches and 24 inches air by 18-inch stroke.

Auxiliary air and circulating pumps, two Blake horizontal simplex, 10 inches steam, 12 inches and 12 inches air and 12 inches stroke.

Main feed pumps, four 16 by 12 5-8 by 18-inch Blake vertical simplex.

Fire and bilge pumps, two 10 by 9 by 12-inch Blake duplex piston.

Ballast pumps, two 8 by 16 by 12 by 18-inch Blake vertical simplex compound.

Fire and ballast pump, in fire room, one 10 by 8 by 12-inch Blake vertical simplex.

Sanitary pump, one 8 by 7 by 12-inch Blake horizontal piston duplex.

Sanitary pump, one 8 by 12 by 12 by 12-inch Blake compound horizontal duplex.

Hot well pump, one 8 by 12 by 18-inch Blake vertical simplex.

Evaporator feed pump, two 6 by 6 by 8-inch Blake vertical simplex.

Distiller fresh water, one 6 by 6 by 8-inch Blake vertical simplex.

Combined fresh and salt water to distiller, two 4 1-2 by 3 by 3 by 4-inch Blake vertical simplex.

The propellers are 19 feet 6 inches diameter, 25 feet pitch, and with three detachable blades. The hubs are cast steel and the blades are manganese bronze.

The steam generating plant consists of six double end and two single end Scotch boilers and one vertical donkey boiler. The main boilers are arranged in two compartments. Three double end and two single end are in the after compartment, and three double end in the forward compartment. All are arranged with axes fore and aft, and with athwartship fire rooms at each end of the double end boilers, one being between the double and single end.

The double end boilers are 16 feet 0 inches mean diameter and 20 feet 3 inches long. Each has 6,416 square feet of heating surface and 153 square feet of grate surface. There are eight 40-inch corrugated furnaces, and 1,152 2 1-2-inch tubes. The single end boilers are 16 feet 0 inches mean diameter and 10 feet 5 1-4 inches long, with 3,208 square feet of heating, 76 square feet of grate surface, four 40-inch corrugated furnaces and 576 2 1-2-inch tubes. The donkey boiler is on the main deck and is a vertical tubular boiler 6 feet 0 inches diameter and 11 feet 7 inches high over all, with 541 square feet of heating and 21 square feet of grate surface. The steam pressure for all boilers is 200 pounds.

There are two stacks, one over each set of boilers. The stacks are elliptical, the forward one 11 feet 3 inches by 7 feet 9 inches inside and 13 feet 9 1-2 inches by 10 feet 3 1-2 inches outside, and the after one the same outside and 12 feet 9 inches by 9 feet 3 inches inside. Both are 108 feet high above the grates.

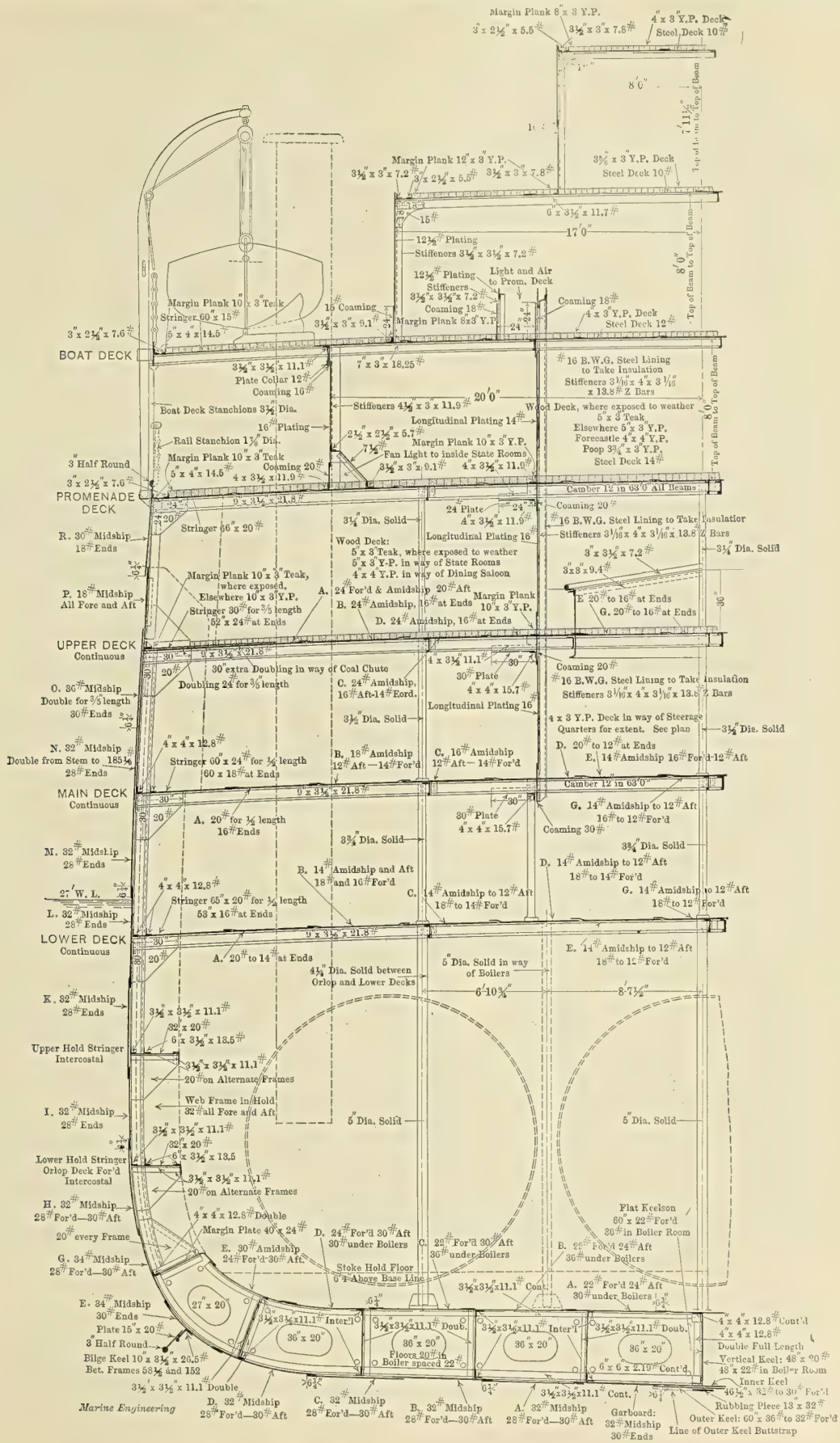
The ship is provided with forced draft on the closed stokehold system and the air is heated by means of air heaters in the uptakes, before it passes into the furnaces. There are thirteen 60-inch blowers with 19-inch tips. Each is run by a separate direct-connected 5 by 4-inch double engine. The length of engine room is 48 feet, after boiler room 58 feet 4 inches, and the forward boiler room is 40 feet.

The steering arrangements on the bridge are expected to be especially satisfactory. There is a chart and wheel house on the bridge deck above the captain's and officers' quarters and with a companionway leading from these quarters up into the chart room. In front of the chart room is the wheel house, containing only the wheel and a compass with a card of the exceptional size of 12 inches diameter. Immediately in front of the wheel house on the open bridge is a glass screen framed in steel. Behind this screen are located the engine telegraphs, steering telegraphs, docking telegraphs, whistle operators, etc. On each side the athwartship bridge extends to the side of the ship with a steel bulwark on the forward side, capped by a teak rail.

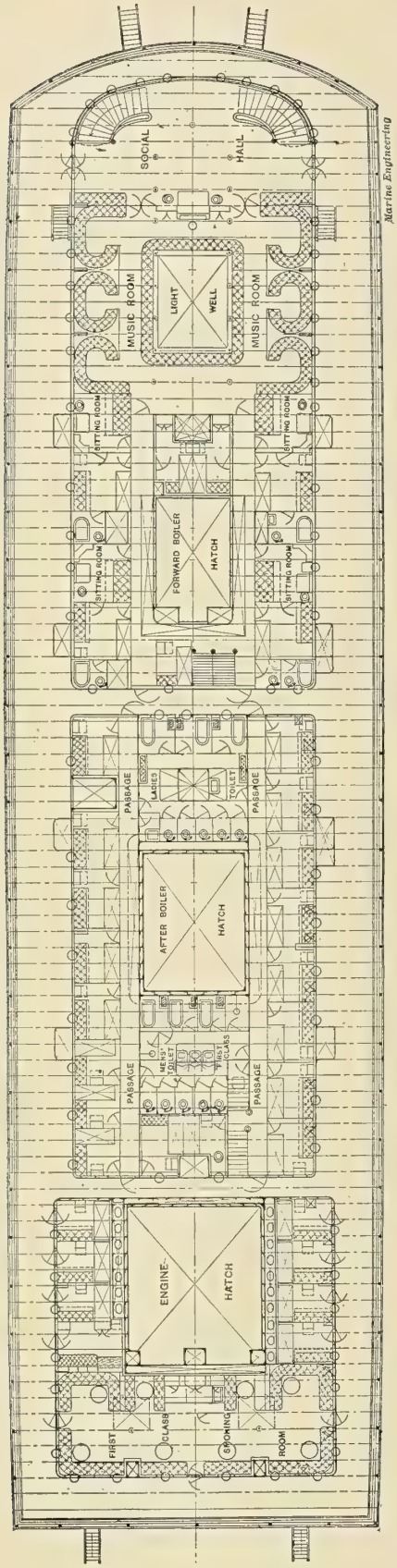
On top of the chart and wheel house is a Lord Kelvin standard compass and a Rushmore searchlight. An electric automatic device is also provided for blowing the whistle automatically at stated intervals during a fog. There is a complete telephone system for officers' communication.

The steering engine is located in the steering gear room aft on the upper deck, and is controlled from the forward station by means of a Brown hydraulic telemotor. The steering gear is of the "Brown Steam Tiller" type, and both steering gear and telemotors were furnished by the Hyde Windlass Company. The steering engine is carried on the tiller and moves around with it. The engine drives, through an expanding clutch, a worm, which in turn drives a worm wheel and a pinion, both on the same vertical shaft mounted in the end of the tiller. The pinion meshes into a rack segment bolted to the deck. The engine receives and exhausts steam through a double stuffing box on the axis of the rudder head. Two oil pumps provide ample lubrication for the whole apparatus. The steering valve is operated by a lever which is brought back to mid position as the tiller moves around. This lever is connected to the after telemotor cylinder. The telemotor can be controlled from a small hand wheel in the steering gear room, or from the hand wheel in wheel house on forward bridge. The gear is generally similar to that used on the *Campania, Lucania, Kaiser Wilhelm der Grosse, St. Paul* and others.

There is also a hand gear consisting of three hand wheels aft of the rudder head, driving through worm and wheel, a pinion which meshes into a segment secured to the rudder stock. There is also a way of operating the tiller by means of the port steam warping capstan on the poop deck. This is done by extending the capstan shaft down into the steering gear room. A chain wheel is fitted at its bottom, and a chain led from this wheel around sheaves in the end of the segment on deck and then attached to each side of the tiller. Thus the ship may be steered by power from the wheel house on forward bridge, from the steering gear room, or by means of the steam capstan on the



MIDSHIP SECTION OF THE STEAMSHIP KOREA.



PROMENADE DECK, STEAMSHIP KOREA.

poop, and by hand from the steering gear room. A telltale compass with 7-inch card is provided in the steering gear room for that purpose.

For cargo handling there are five hatches on the open decks, two in each well and one on the poop. Besides these there are six cargo ports on each side of the ship opening into the main deck space. Two of these give access to two blind hatches under the dining saloon. In the forward well are two derrick posts each fitted with two booms capable of handling seven tons each. In the after well there are four posts and four booms as above. In each well there are four winches 8 inch by 8 inch double reversible, each provided with a wire rope drum and with two winch heads, and capable of exerting a pull of 5,000 pounds on one head. The posts in the forward well are also supplied with guys and fittings so that a boom capable of lifting 30 tons may be rigged over the after hatch, and a special boom is carried for this purpose. Arrangements are made for lifting this immense load in order to enable the ship to load and unload heavy mining machinery, armor plate, etc., which it is anticipated will be carried to China and Japan. On the poop deck are two other derrick posts and booms capable of handling two tons each and one winch similar to the above to operate them. Over the blind hatches in main deck, under the dining saloon, are two hatch cranes of two tons capacity each, with one winch similar to the above, except with double drum, to operate them. All winches are furnished by the Hyde Windlass Company. Besides the above there is a small 6 by 6 inch double winch with three heads, located on top of house on boat deck abaft the forward stack, which is used exclusively for handling life-boats.

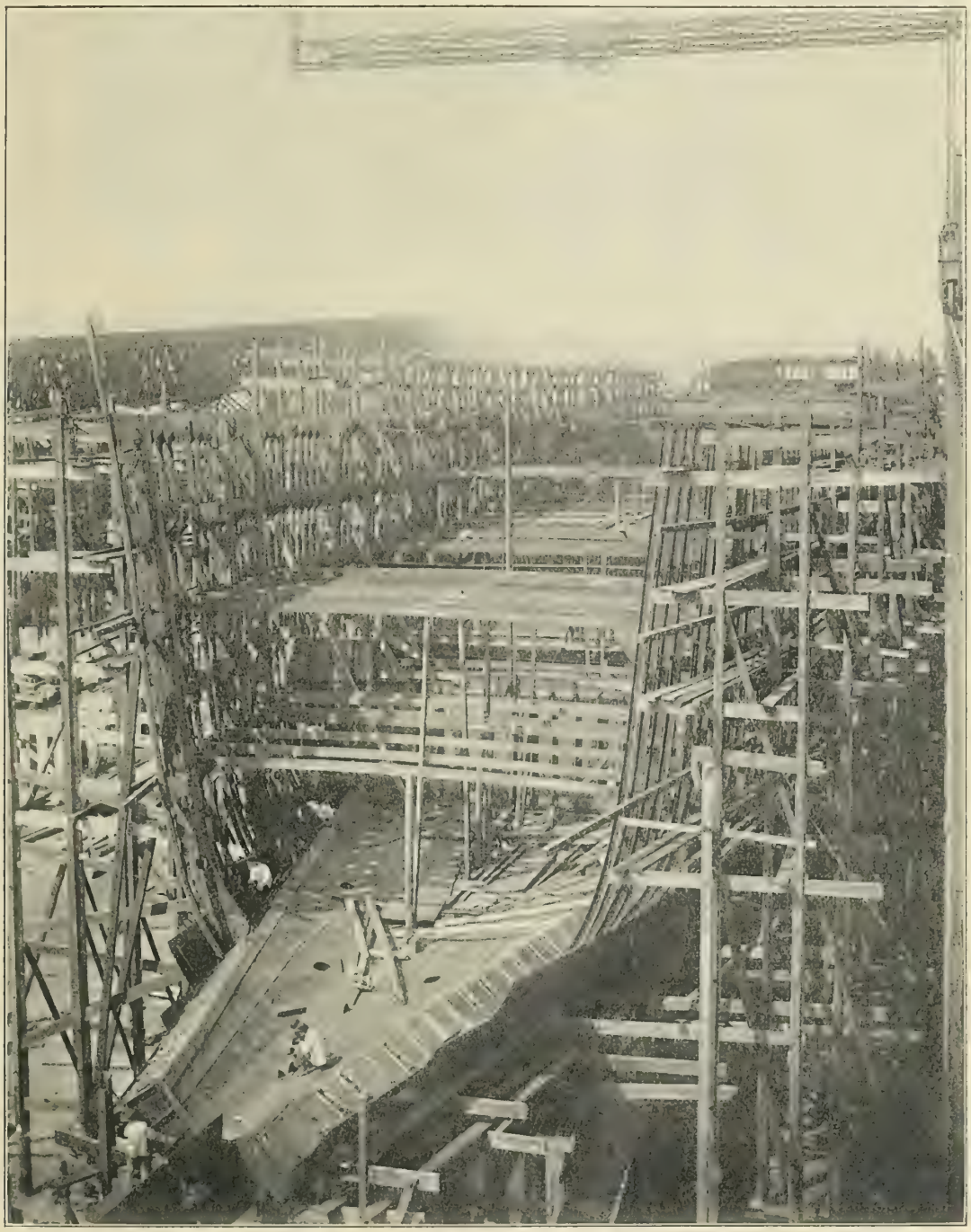
The anchor handling and the warping appliances consist of a two-cylinder reversible 16 by 14-inch windlass in the open on the forecastle deck, and two steam warping capstans on the poop. The windlass is fitted with two wildcats for handling 3-inch stud link chain cable, and with two "nigger heads." It is also arranged to operate the three warping capstans on the forecastle. There are three bower anchors, one weighing 15,680 pounds and two 12,320 pounds each. All are of the Dunn stockless type.

On the poop deck aft there is a Lord Kelvin sounding machine for taking soundings over the stern at any depth and any speed of the ship.

One of the most interesting and complete installations on the ship is the refrigerating plant. It is on a very large scale even for this class of vessel, and is provided with the idea of carrying cargo in cold storage as well as with the idea of furnishing the passengers with all the luxuries and delicacies that cold storage makes possible. The plant was furnished by the Vulcan Iron Works, of San Francisco, Cal. It consists of two special steamship 8-ton refrigerating machines, each consisting of compound steam engines and compound ammonia compressers. Brine tank and cooling coils are provided equal to the capacity of one of the above machines. The machines are cross connected so that they may be operated independently, or both together. They are in duplicate so as to have one machine at least always ready to operate on the system, and to provide for a future increase if desired.

The brine coils cool about 1,321 square feet of floor space, shown aft of the engine room on the main deck, and at the same time make 1,200 pounds of ice every 24 hours in blocks of 70 pounds each, and cool the water in two 15-gallon drinking water coolers.

insulated from the ship's structure, the walls being filled with mineral wool. The refrigerating machines are in a room abreast the engine room on the main deck and just abaft the dynamo room. The ammonia condensing coils are in the bedplates of the machines,



SHOWING THE WATER BOTTOM AND BOW FRAMING OF THE SIBERIA.

The refrigerated space is divided into rooms for meat, vegetables and fruit, butter and eggs, flour, dry stores and wines, etc., all provided with appropriate fittings, hooks and shelving. All spaces are thoroughly

and circulating water is pumped through from the sea by independent pumps in the same room.

Just forward, as mentioned above, are two 35 K. W. generating sets consisting of 6 pole dynamo, 318 am-

peres at 400 r. p. m. and tandem compound 7 1-2 by 12 1-2 by 6-inch direct connected engines. This plant furnishes current for 820 lights throughout the ship, for the search light and for the two ventilation blowers for passengers' quarters. One machine is capable of taking care of the ordinary service required, so that there is always opportunity for overhauling the other and there is plenty of reserve power if required. The generating sets were furnished by the General Electric Company.

Directly across the ship from the dynamo room is an engineers' work-shop containing one 16-inch swing lathe 12 feet 6 inches between centers, one 25-inch drill press, one small drill press, one 16-inch shaper, a pipe threading machine, emery wheel, grind stone and vice bench. Power is supplied by a 7 by 7 inch independent engine driving through line shafting and belting.

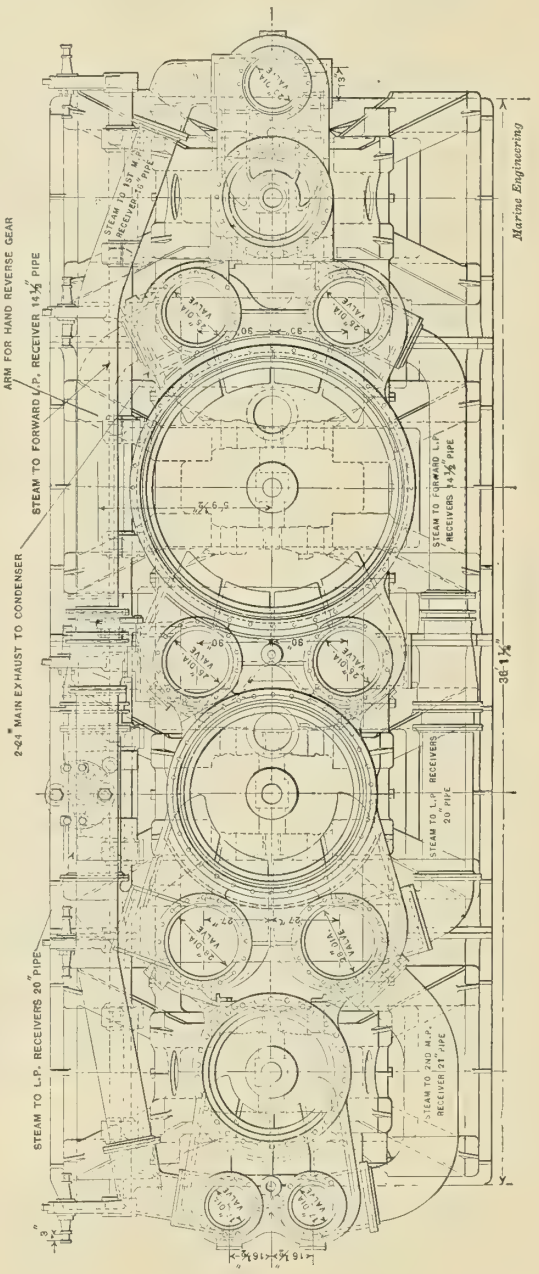
The accommodations for passengers and crew are confined entirely to the boat, promenade, upper and main decks, where there are provided quarters for 200 first-class passengers, 60 white steerage, 1,200 Chinese steerage and 236 crew.

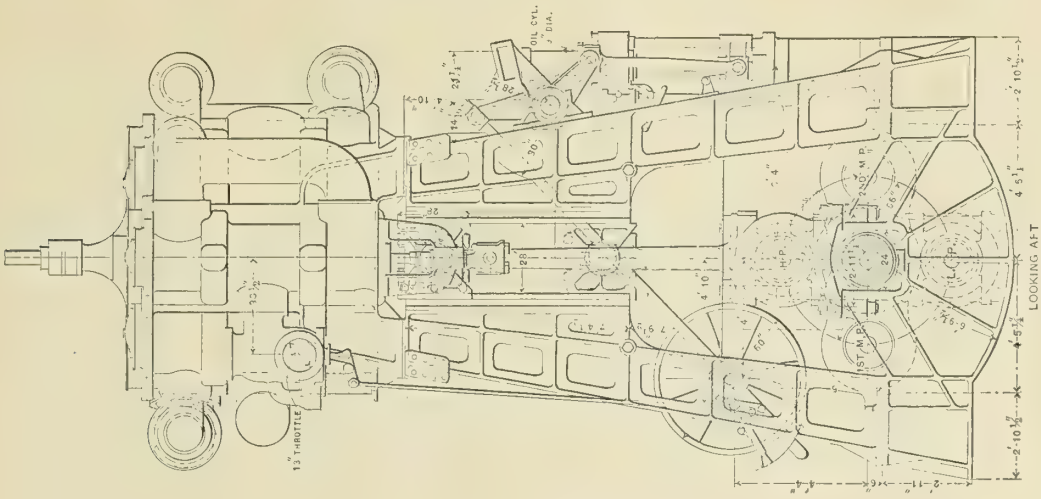
On the boat deck forward is a house devoted almost exclusively to officers' quarters, with a companion leading directly up into the chart room, as described in another place. The captain is provided with a stateroom and a cabin occupying the entire front of the house, and with an outlook ahead and on both sides of the vessel. The stateroom has fixed bedstead and wardrobe, and the cabin a table, upholstered transom, roll-top desk, mahogany leather cushioned chairs, etc. There are staterooms for 9 officers besides the captain, and separate bath rooms and water closets for the captain and for the officers.

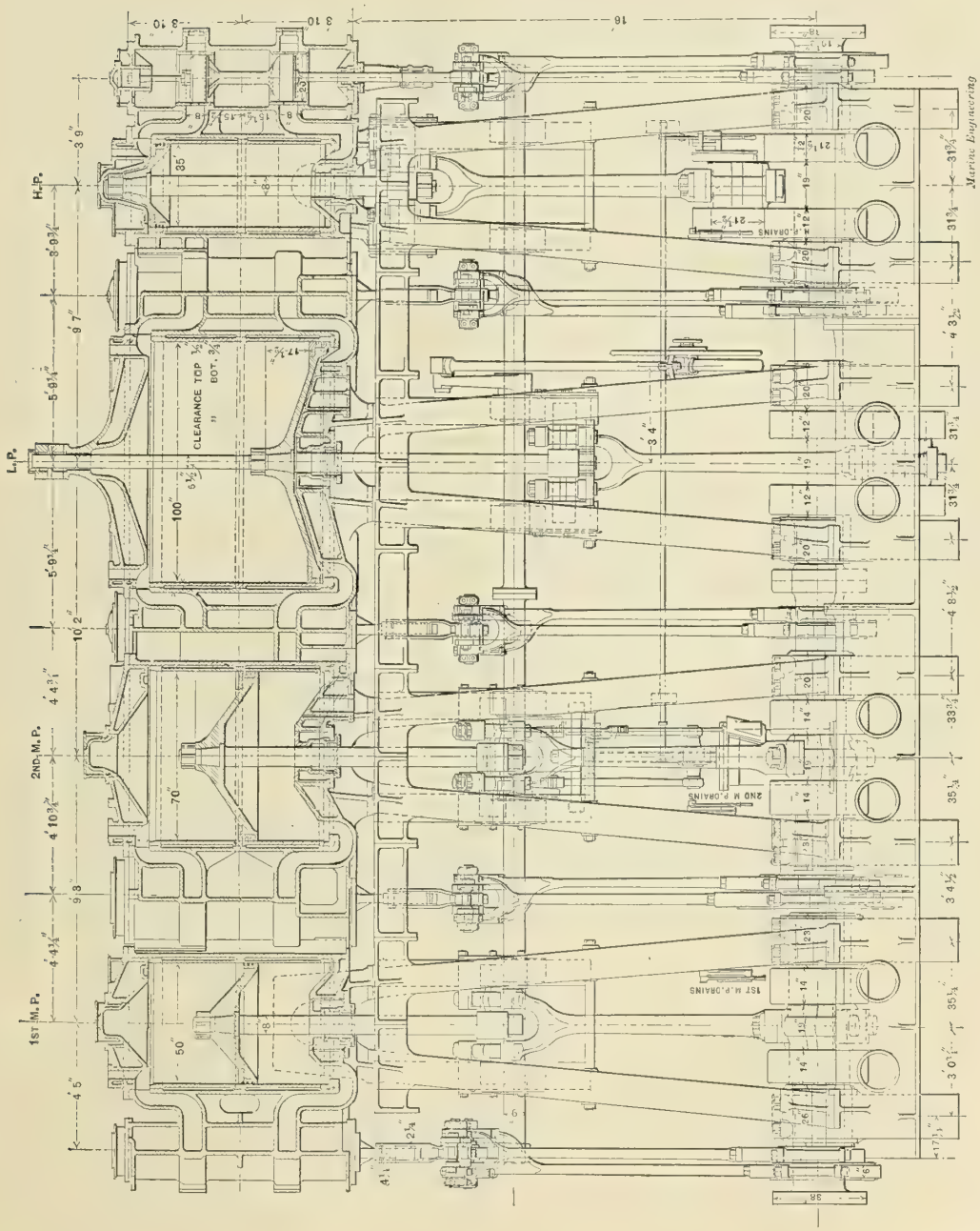
The bulk of the first-class passengers' staterooms are on the promenade and the upper decks. The upper deck is so arranged that the passenger quarters are all on the starboard side; and the galleys, pantries and quarters for the servants and crew, together with entrances to boiler and engine rooms, are all on the port side, with no passage across the ship. All along the port side from well to well there runs a working passage which provides all necessary communication for servants and crew and enables all the service of the ship to be performed without intruding upon the first-class passenger quarters. This arrangement is rather odd, in that it gives the ship a distinctly different appearance when viewed from port and from starboard, but it possesses many excellent qualities in the way of increased working facilities and minimum annoyance to passengers.

The first-class staterooms are all paneled in white, with dark cherry trimmings. Each is provided with a white enameled iron bedstead, brass fittings, upper and lower berths. There is in each room also a transom seat capable of being pulled out and converted into a berth, and a folding lavatory stand with porcelain and cut glass fittings.

On the promenade deck forward, and with an outlook forward and on both sides of the ship, is the social hall, floored in slate and white rubber tile, upholstered in red plush, and the walls ornamented with panels in staff work above a mahogany wainscoting. In this room also are provided two double mahogany writing desks, with all accessories, for the use of passengers. Between the social hall and the music room, which is just abaft of it, are double swinging doors with small panes of bevel plate glass. Leading from the social hall to the dining saloon below, is a double stairway of solid bronze with ornamental railings and newel posts. The dining saloon seats 202 people and is finished entirely in olive green, white and gold. The carpet is olive green, the upholstering is plush of the same color and the panels of the walls are ornamented and tinted in light green, ivory and gold. In the center of the saloon is a light well to the music room above, and thence through a trunk to a skylight dome on the bridge deck. The decks at this well are supported on fluted columns with ornamental capitals. The trunk is ornamented with lincrusta panels showing


Marine Engineering
ARM FOR HAND REVERSE GEAR
STEAM TO FORWARD L.P. RECEIVER 14½" PIPE
2-24" MAIN EXHAUST TO CONDENSER
STEAM TO L.P. RECEIVERS 20" PIPE
STEAM TO FORWARD L.P. RECEIVERS 14½" PIPE
STEAM TO L.P. RECEIVERS 20" PIPE
STEAM TO 2ND M.P. RECEIVER 21" PIPE
36 1½"
PLAN OF CYLINDERS.





FOUR CYLINDER QUADRUPLE EXPANSION ENGINE FOR THE KOREA.
Marine Engineering

NAME—Korea. NATIONALITY—American. TYPE—Ocean Passenger and Freight Steamship

LAUNCHED—1901. BUILDER—Newport News S. & D. D. Co. OWNER—Pacific Mail Co.

Length over all	572 ft. 4 in.
Length between perps	550 ft.
Breadth, molded	63 ft.
Depth at side, mid length	40 ft. 10 in.
Depth at side, lowest point of sheer	40 ft.
Depth at center	41 ft. 10 in.
Block, coeff	.69
Prismatic, coeff	.72
Midship section, coeff	.96
Load draft	27 ft.
Load displacement	18,400 tons
Wetted surface	57,000 sq. ft.

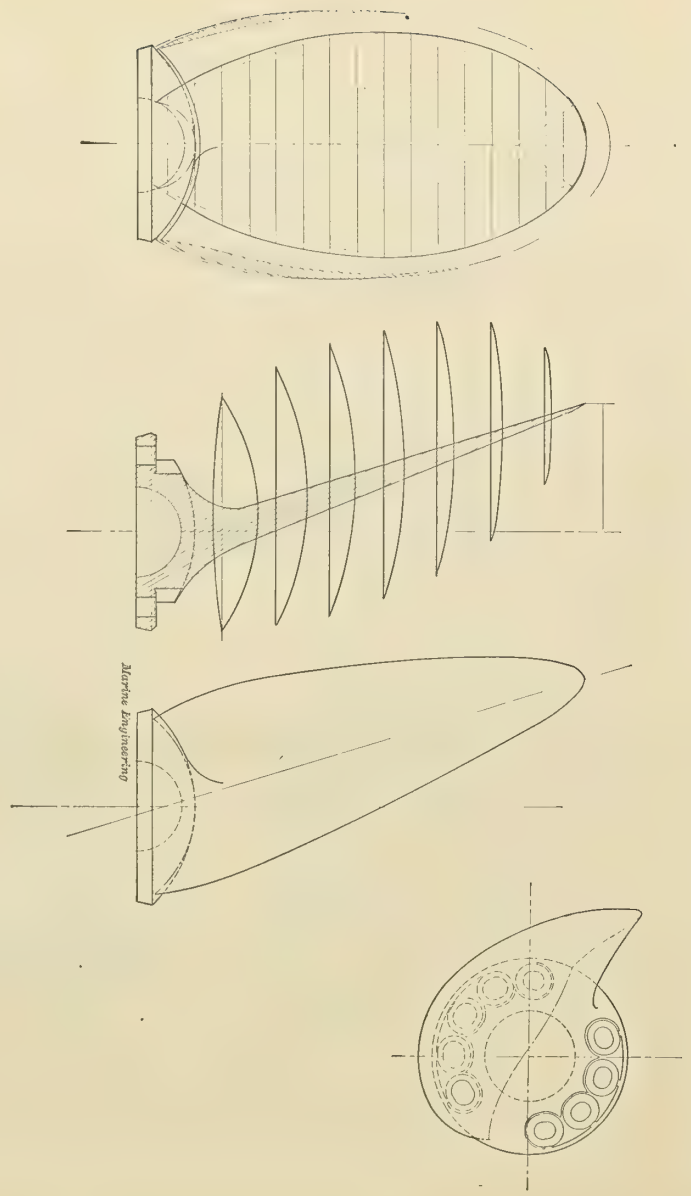
Cargo capacity	510,466 cu. ft.
Coal bunkers	2,583 tons
Tanks:—	
Forward peak	225 tons
After peak	271 tons
Water bottom	2,124 tons
Deep well	526 tons
Propellers, number blades	3 each
Diameter	19 ft. 6 in.
Pitch	25 ft.
Material, Manganese bronze, cast steel hubs	
a, developed, each	101.4 sq. ft.

NAME—Korea. NATIONALITY—American. TYPE—Ocean Passenger and Freight Steamship

LAUNCHED—1901. BUILDER—Newport News S. & D. D. Co. OWNER—Pacific Mail Co.

Engines, number	2
Type	Quadruple 4 cylinder 4 crank
Cylinder diameters	35, 50, 70, 100 in.
Stroke	66 in.
I. H. P., trial	17,900
R. P. M., trial	89
Speed trial at load draft	20 knots
Condens. surf, two main	23,574 sq. ft.
Valves	All piston
Boilers, number	2 single, 6 double-end
Type	Scotch
Pressure	200 lbs.
Length, single end	10 ft. 5 1-4 in.

Length, double-end	20 ft. 3 in.
Diameter	16 ft.
Furnaces in each end	4
Furnace diameter	40 in.
G. S. total of boilers	1,070 sq. ft.
H. S. total of boilers	45,912 sq. ft.
Draft	Closed stoke hold
H. S. ÷ G. S.	42.91
H. S. ÷ I. H. P., trial	2.56
I. H. P. ÷ G. S., trial	16.91
Height of stack above grates	108 ft.
Donkey Boiler	Vertical tubular
Size	6 ft. diam. by 11 ft. 7 in high

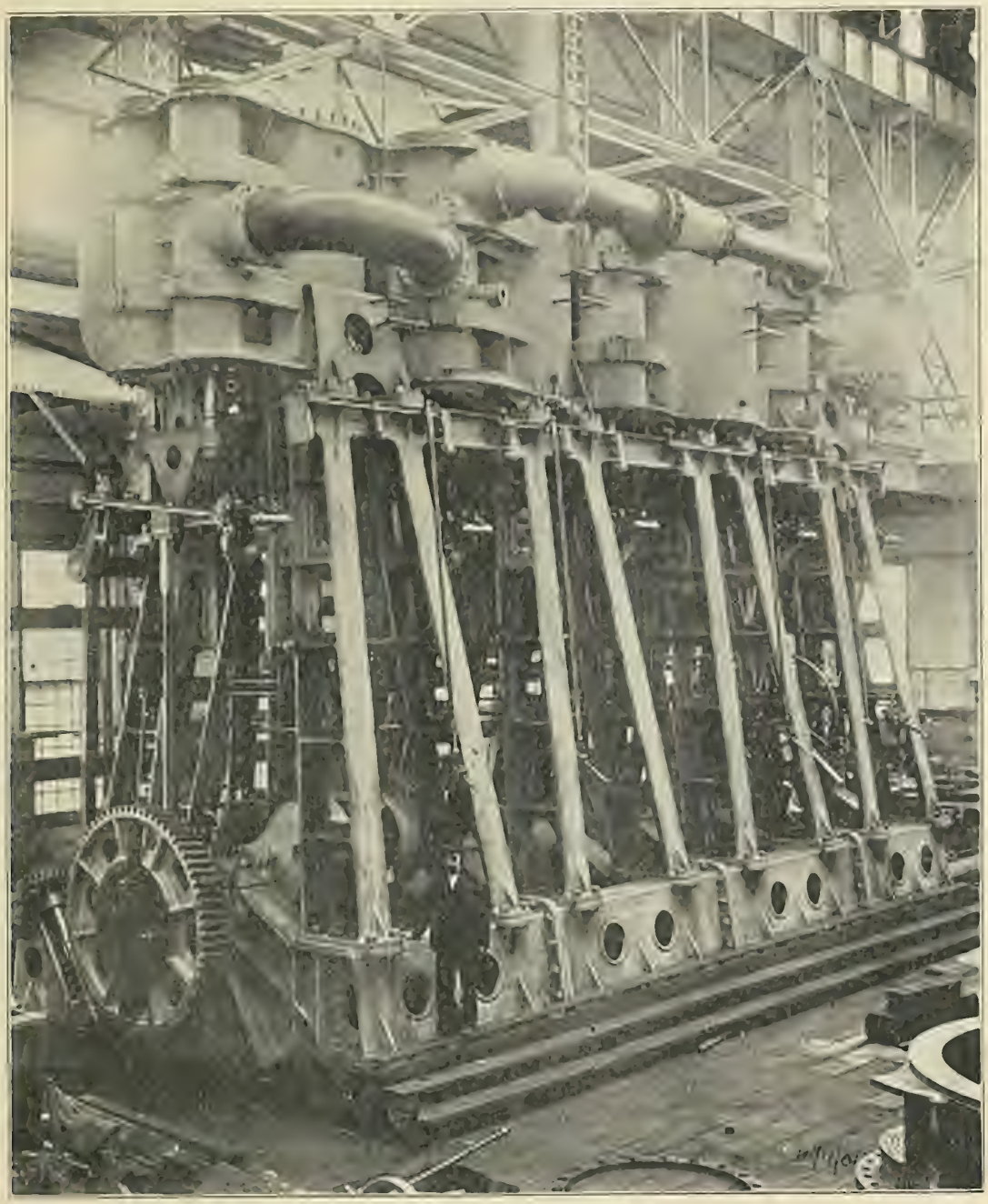


PROPELLER BLADE OF THE KOREA.

Marine Engineering

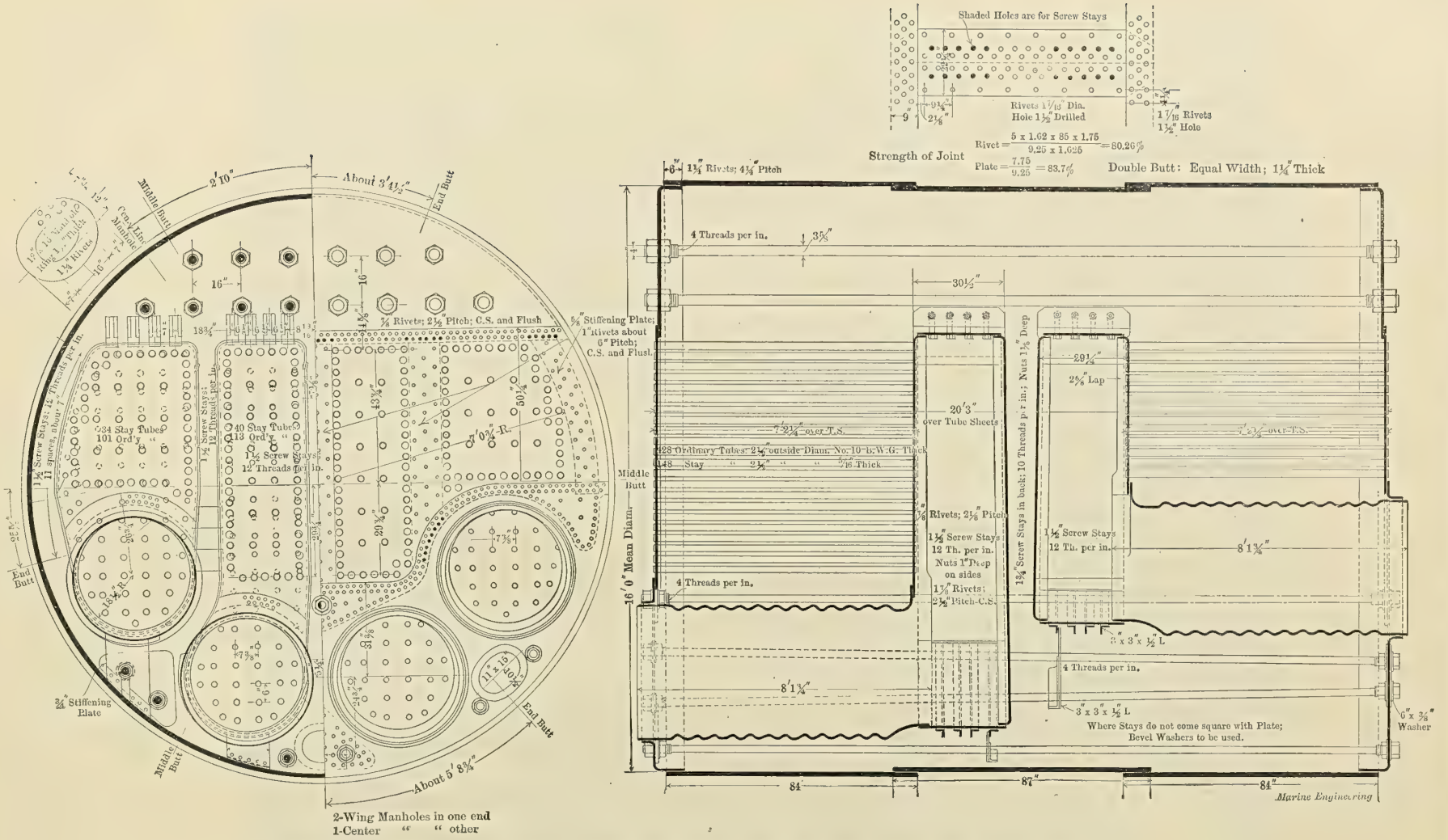
figures in bas-relief, tinted as described, and the arched skylight above is worked in leaded glass of a conventional floral design in olive green set in an opalescent ground. At night the skylight is illuminated from above with electric lights, the well is lighted with electricity, and lights are set in the ceiling panels of the dining saloon, the whole giving an exceedingly pleasing effect.

The music room, just abaft the social hall, is divided around the sides into numerous booths with a transom running around the inside of each, so that a number of parties may each obtain a considerable privacy. The whole is carpeted in red and upholstered in dark red plush. The woodwork is mahogany and the staff panels are tinted in light colors to harmonize with the general rich red effect. The light well described above passes through the center of the music room and may be looked into from this point. It is surrounded by an upholstered seat in red plush, and the bases of the fluted columns land on the broad top rail of this seat.



QUADRUPLE EXPANSION ENGINE OF THE KOREA, ERECTED IN THE MACHINE SHOP.

In the forward end of the music room is a piano flanked by mahogany music stands and bookcases. The whole is abundantly lighted by electricity and each booth has its separate group of lights. Just abaft


Shaded Holes are for Screw Stays
Rivets 1 7/16" Dia.
Hole 1 1/2" Drilled
1 7/16 Rivets
1 1/2" Hole
Strength of Joint
Rivet = 5 x 1.62 x 85 x 1.75 / 9.25 x 1.625 = 80.26%
Plate = 7.75 / 9.25 = 83.7%
Double Butt: Equal Width; 1 1/4" Thick
6" 1 1/8" Rivets; 4 1/4" Pitch
4 Threads per in.
3 5/8"
30 1/2"
29 1/2"
2 5/8" Lap
20'3" over Tube Sheets
7'2 1/4" over T.S.
7'2 3/4" over T.S.
128 Ordinary Tubes 2 1/2" outside Diam. No. 10 B.W.G. Thick
48 Stay " 2 1/2" " " 5/16 Thick
7/8" Rivets; 2 1/8" Pitch
1 1/2" Screw Stays 12 Th. per in. Nuts 1" Deep on sides
1 7/8" Rivets; 2 1/2" Pitch C.S.
1 1/2" Screw Stays 12 Th. per in.
1 3/4" Screw Stays in back; 10 Threads p. r in.; Nuts 1 5/8" Deep
8'1 3/4"
3" x 3" x 1/2" L
3" x 3" x 1/2" L
Where Stays do not come square with Plate; Bevel Washers to be used.
6" x 3/8" Washer
16'0" Mean Diam.
Middle Butt
End Butt
84"
84"
84"
Marine Engineering
2'10"
About 3'4 1/2"
About 5'8 3/4"
16"
7/8" Rivets; 2 1/8" Pitch; C.S. and Flush
5/8" Stiffening Plate; 1" Rivets about 6" Pitch; C.S. and Flush.
34 Stay Tubes
101 Ord'y "
40 Stay Tubes
113 Ord'y "
1 1/2" Screw Stays; 12 Threads per in.
5'0 3/4" R.
3/4" Stiffening Plate
2-Wing Manholes in one end
1-Center " " other

DOUBLE END BOILER FOR THE KOREA. THERE ARE SIX OF THESE AND TWO SINGLE END OF THE SAME DIAMETER.

the music room are four sets of staterooms en suite. The two sets on the starboard side of the ship are finished in mahogany and those on the port side in quartered oak. Each set consists of a sitting room, stateroom and private bath and closet. The sitting room is furnished with upholstered transom, folding corner lavatory and writing desk, each stateroom with solid brass bedstead, transom and folding lavatory, and each bath room with water closet and solid porcelain tub with hot and cold water. The passages are all carpeted and finished in white panels with cherry wainscoting.

On the extreme after end of the promenade deck house is the smoking room, having an outlook aft and on both sides of the ship. It is tiled in red and white rubber, upholstered in red plush and the woodwork is cherry of a rich wine color. The panels are lincrusta finished in old Dutch gold. In the center is an enclosed buffet for the accommodation of passengers. On each side, and around the ends of the houses on this deck, is an uninterrupted promenade 550 feet in the circuit, or over a tenth of a mile.

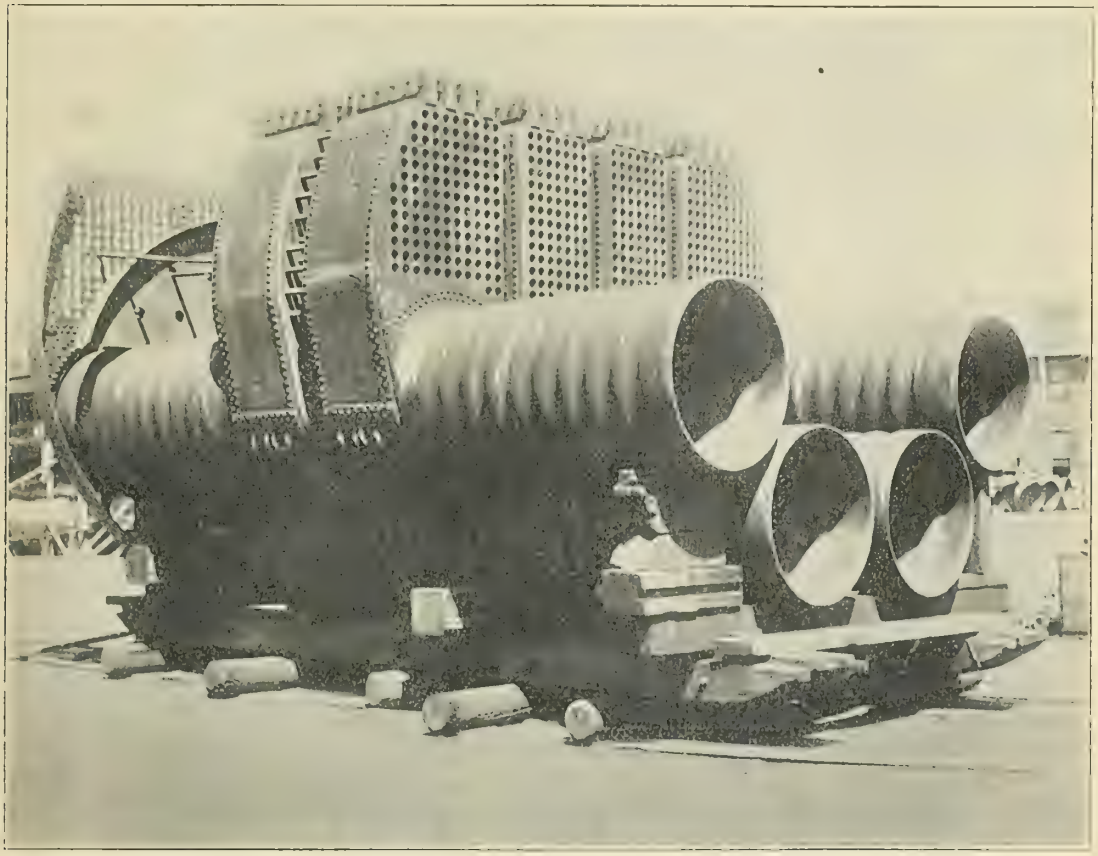
The plumbing arrangements for first-class passengers are most elegant and elaborate. Extensive toilet rooms are provided for ladies and for gentlemen on both the upper and the promenade decks, all floored in mosaic marble tile. The water closets in all are in stalls separated by opalescent glass partitions. Each closet has separate flushing valve and all nickel fittings. The bath tubs are solid porcelain embedded in the tiled floor, and each bath room is provided with a folding wooden seat.

The galley and pantry arrangements are also extensive and all are fitted up in the most modern style with every possible convenience for rapid and efficient service. The pantry opens directly off the main dining saloon with double swinging spring doors between, and a screen on the pantry side.

The servants' and crew's quarters are ample and are all fitted in a neat and comfortable style. The crew's and steerage wash rooms and water closets in the forecastle are floored with cement tile and fitted with wash troughs and with galvanized iron latrines with intermittent flush. The same is true of the firemen's and stewards' quarters under the poop. The white steerage forward on the main deck is fitted permanently in a neat fashion. The spaces forward and aft on the main deck are fitted for cargo or for Chinese steerage. For the latter purpose portable metal standee berths are provided. All steerage spaces are light, airy and well ventilated.

A most thorough and efficient ventilation is provided for all first-class passenger spaces by means of electric fans and ventilation ducts.

Aft on the starboard side is the bridge house; near the purser's office and stateroom is a doctor's room



COMBUSTION CHAMBERS AND FURNACES FOR ONE OF THE DOUBLE END BOILERS OF THE KOREA.

and also a barber shop. The chief engineer's stateroom is a large room opening directly off the engine hatch on the promenade deck.

On the main deck just forward of the machinery space is a large baggage room, and also a mail and specie room, with every facility for handling baggage through the cargo ports in the immediate vicinity.

At the time of their launch these ships had reached the great weight of about 7,200 tons. The sliding ways were about 470 feet long under the packing and 3 feet 6 inches wide each, thus giving an average pressure of about 2.2 tons per square foot. The pressure on the fore poppets at the point of pivoting was estimated to be about 1,400 tons. The ships slid about 468 feet to the point of pivoting, and the time from sawing off to pivoting for the *Korea* was 42 seconds. The packing aft under the heavy sternpost and struts was necessarily of an unusually extensive character. The whole method of packing and launching was that which has been used so long by Mr. M. V. D. Doughty, the superintendent of hull construction at the yard, and which has accomplished a very large number of successful launchings. The launchings of these two immense vessels were carried on with the precision of clockwork and were as eminently successful as those that had gone before.

The *Korea* went on a 36-hour sea trial on March the 20th at her load draft of 27 feet 0 inches. This trial was most successful, and the engines were not stopped from the time she left the dock until she reached it again. Under forced draft the engines made 89 revolutions and developed 17,900 indicated horse power. The log indicated a speed of 20 knots, and a rough check on a known course indicated about the same speed. At least the anticipated speed of 18 knots was easily exceeded and should not be difficult to maintain on her regular runs.

The boilers steamed easy and there was remarkably little vibration at any speed of the engines. The ship encountered a northwest gale of considerable violence and rather a heavy sea, but she stood up to it exceedingly well and gave every indication of being a good sea boat.

New Floating Dock at Seattle, Wash.

The accompanying engravings show the floating dry dock recently put in service by Moran Bros.' Company. It is the first of two similar sections of a combined lifting capacity of 5,000 tons. This section is 85 feet wide over all, 57 feet between towers, and 250 feet long. The keel blocks are located 4 feet center to center. The dock is built very heavily of timber, and the main pontoon is divided into twelve compartments. Each tower is divided into three compartments, making in all eighteen compartments. The water level in each one of these compartments is plainly shown by pole indicators located on the top of the towers. The pumping machinery consists of centrifugal pumps, each run by an electric motor, and the operation of the dock is controlled entirely by one person situated in the conning tower, which, as shown in the engraving, is located at one end of one of the main towers.

FLOATING DOCK AT SEATTLE ABOUT TO BE LAUNCHED.

The dock is giving highly satisfactory service and work on the construction of the second section is soon to be started.

Salving the Flottbek.

During the gale of November 23rd the German ship *Flottbek* was driven ashore at Long Branch, N. J., and at low tide was left in the position shown in the accompanying engraving. Upon examination it was found that the steel hull of the ship was practically uninjured. That the ship escaped striking any of the numerous jetties that are built along the beach at this point was almost miraculous. As shown in the engraving, she lay fast in the sand directly between two of these jetties.

The Merritt and Chapman Derrick and Wrecking Company undertook to pull the vessel off; her topmasts and yards were lowered and most of her cargo, which consisted of China clay and arsenic, was discharged. Two anchors were taken out astern in the direction from which the ship had come when she struck, and by these the ship was held from being driven further on to the beach and the cables were laid to windlasses. Preparations were completed and the crew waited for another storm to agitate the water and sand around the stranded vessel, and, on December 17th, when such a storm came, the cables were hauled in by working the capstans, and the ship was successfully floated.

This strip of Jersey coast is the scene of many wrecks. The *Flottbek* was built by Swan and Hunter, at Newcastle, in '91, and is 273 feet long, 42.1 feet broad, 24 feet deep, and of 1,888 tons.

GERMAN SHIP FLOTTBEK ASHORE ON THE JERSEY COAST.

Shipping Combine.—Laird's Shipbuilding Company, of Birkenhead, England, has taken over the adjoining Jones Shipyard gaining control of a large area of the Mersey. This combine now intends to compete with the leading shipbuilders of the country for building ships of the largest class.

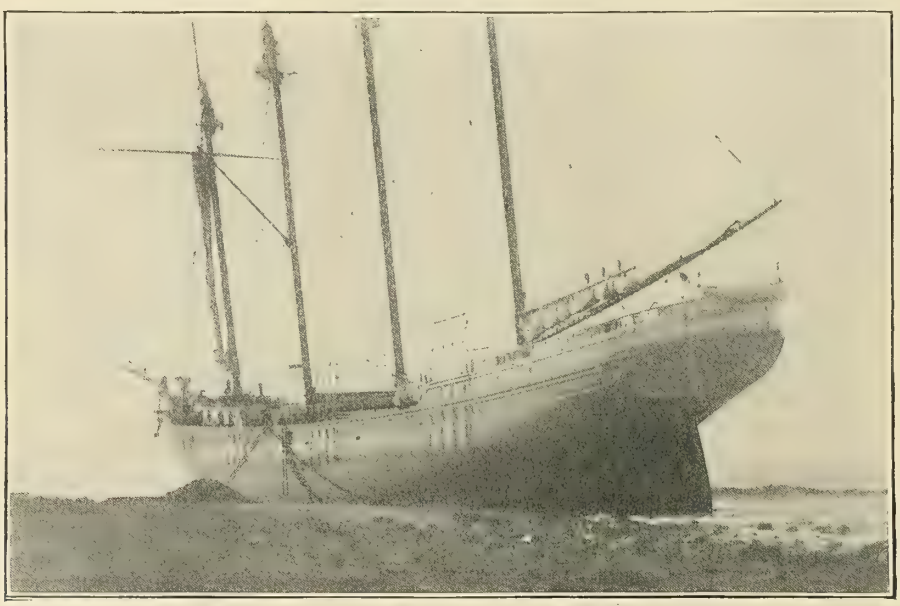
Lake Shipbuilding.—The Great Lakes are building a larger number of merchant ships than ever before in their history, although the cost is less than that of the vessels under way a year ago. The 500-foot class that seemed two years ago to be the coming type, is being replaced by ships of from 400 to 430 feet long, carrying from 5,000 to 6,000 tons. There are twenty-eight steel cargo ships under way in the yards of the American Shipbuilding Company, and every one is of this type.

Steamship Traffic of the Northwest.—The development of the shipping business of the Pacific Northwest has progressed with remarkable strides during the last few years. Fifteen years ago there were two steamships in this trade. To-day the list of foreign steamships en route for and in port at Portland, Seattle, Tacoma, Vancouver and Victoria includes 45 big carriers ranging in capacity from 4,500 tons to 10,000 tons, the net registered tonnage of the fleet being over 108,000 tons, and the carrying capacity about 250,000 tons. Despite the enormous carrying capacity of this fleet the business of the sailing ships has not decreased, but increased.

Schooner on Shore.

Herewith are presented two interesting photographs of the schooner *Minnie A. Craine*, which was thrown on the beach on the west side of Smith's Island, Puget Sound, during a severe storm on the night of December 25th last. Although the vessel was stranded too high to be readily floated, she is resting easily and may be saved. A portion of the keel was torn off and the damage to her bottom allows the sea to rise in her hold at high tide. She was built by Moran Brothers, Seattle, during the year 1900, and is of the following dimensions: Length, 205 feet 9 inches; beam, 42 feet 2 inches; depth, 16 feet 7 inches. She was very heavily built throughout, her rigging and fittings were the best, as was the workmanship, and it is hoped that these qualities will maintain the vessel in good condition long enough to enable her owners to restore her to the intended element. She left Puget Sound with a cargo of lumber for Australia almost exactly one year before the ill-fated day on which she re-entered the Sound to be wrecked as above described.

BOW VIEW.



SCHOONER STRANDED ON SMITH'S ISLAND, PUGET SOUND.

Steel Famine.—Owing to the unprecedented demand of steel for structural work, all of our shipyards are suffering because of the impossibility to get deliveries of steel from the mills. All plants report that they are far behind with their orders.

Losses on Torpedo Boats.—The board of naval officers, of which Rear Admiral Francis M. Ramsay was chairman, appointed by Secretary Long to fix the amounts lost by contractors in constructing torpedo boat destroyers and torpedo boats for the government, has reported that the average loss on each destroyer was $87,459 and on each torpedo boat $72,531. The total loss of the contractors on the sixteen destroyers, as fixed by the board, was $1,399,340, and on torpedo boats $652,778, a grand total of $2,052,118. These figures will be sent to Congress for its information in considering claims of the contractors for reimbursement to the amount of one-half their losses, or $1,026,059.

The board's report was referred to the Bureaus of Steam Engineering and Construction, which informed the Secretary of the Navy that they regard the average cost fixed by the board as fair and moderate. They say that the excess of cost over the contract prices to which the contractors were put was due to an increase in the price of material and the long periods that the vessels were under construction.

THE BALLASTING OF MODERN TANK STEAMERS.*

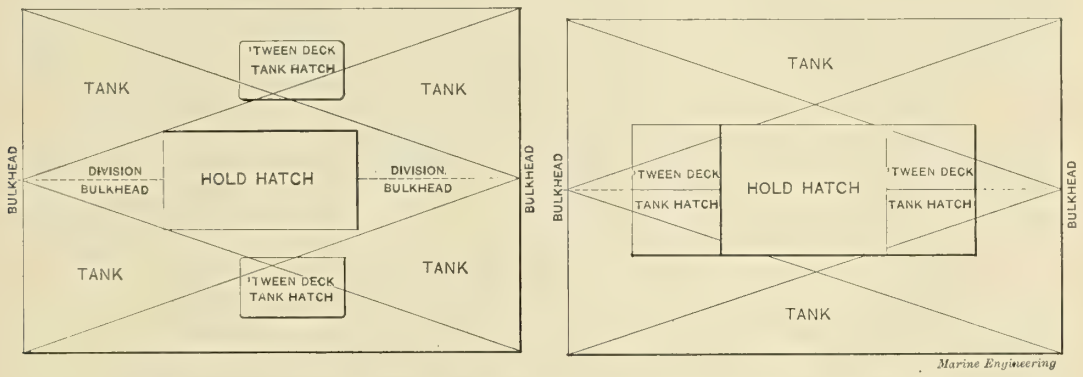
E. C. CHASTON.

If we go back to January, 1897, and take from that date the salvage cases due to broken shafts, loss of rudders, etc., up to the present time, one can only express surprise that such a state of things is allowed to exist. Writing as one who has had a practical knowledge of the subject, the writer admits that until about four years ago he was inclined to think there was something radically wrong with the shipbuilding and marine engineering profession, respecting the scantlings of both hulls and machinery. But after carefully looking into the cause of shaft breakages and disabled rudders, broken or fractured rudder posts, etc., he came to the conclusion that insufficient ballast was and is the cause of three-fourths of the whole trouble, and that it is imperative (if the shipowner will not, and the underwriter does not, insist upon a vessel being sent to sea in proper ballast trim) that there should be an under-load line fixed by the Board of Trade or the authorized freeboard-assigning authorities. With the present type of 6,900 to 7,000 tonners, length B. P., 350 feet; breadth, 47 feet; depth, molded, 29 feet 6 inches; with all tanks full, boilers full, stores on board and 600 to 700 tons bunker coals, ready to sail to the westward, the ballast draft would be approximately 12 feet 3 inches aft and 8 feet 2 inches forward, or a mean draft of 10 feet 2 1-2 inches. If we take the center line of shafting at 10 feet 6 inches from the base line of the vessel and add half the diameter of the propeller boss, say 1 foot 4 1-2 inches, this gives 11 feet 10 1-2 inches from the keel to highest part of propeller boss, or in other words the boss of the propeller is submerged 4 1-2 inches. Apart from this data, which is quite in keeping with present-day practice, the writer has often seen propeller bosses 2, 3 and 4 inches awash on vessels leaving continental and lower Mediterranean ports for United Kingdom coal loading ports.

In addition to the risk of shaft breakages, machinery damage, etc., vessels in the trim described above are quite unmanageable in a fresh breeze, due to the fact that they will not answer their helm, but fall off before the wind and become a source of danger to navigation in such places as the English Channel, Bristol Channel and Irish Sea. . . .

It is surprising to think that shipowners in far too many cases will not go to the expense of paying the cost of the necessary extra ballast to put a ship sufficiently down in the water for a run across the Atlantic light. The cost of sand ballast to-day is a mere bagatelle in comparison with the loss sustained by a long passage owing to the vessel being too high out of the water. To demonstrate the value (to shipowners) of having a ship sufficiently or properly ballasted the writer gives below the performances of a few vessels running across to North America in ballast trim. Steamship A, length, B. P., 340 feet; breadth, extreme, 45 feet; depth, molded, 28 feet; I. H. P., 1,234 to 1,250; speed, 9 knots; dead weight, 5,697 tons on a mean draft of 22 feet 10 1-2 inches. The above vessel, when water ballasted only, and with 600 tons of coals on board, had a draft of 13 feet 2 inches aft and 11 feet 1 inch forward, the distance from the base line to the center line of tail shaft being 10 feet 6 inches, the diameter of shaft 12 1-4 inches, and the diameter of propeller boss 2 feet 9 inches, thus giving 9 1-4 inches immersion of propeller boss in smooth water. The diameter of the propeller is 17 feet. This vessel used to take 19 to 25 days on the passage from the north-east coast port to Hampton Roads, U. S., and Delaware Breakwater, U. S., and invariably arrived with machinery defects and was eventually towed into the Azores with broken shaft and loss of propeller, the shaft having gone at the largest part of the cone. There was no trace of corrosion or other defects, the shaft was in perfect line, and the fracture was as clean a break as anyone could wish to see. The cause was directly traced to want of sufficient ballast. After such experience and consequent loss through delay, salvage and towage home, the owner agreed to have his ships sufficiently ballasted, with the following results, in this particular case of A, on three successive voyages:

August, 1897.—In addition to her water ballast and 600 tons of bunkers, she took 500 tons of sand ballast at 1s. 6d. per ton f.o.b., and sailed from Blyth on August 14th, arriving at the Delaware Breakwater on August



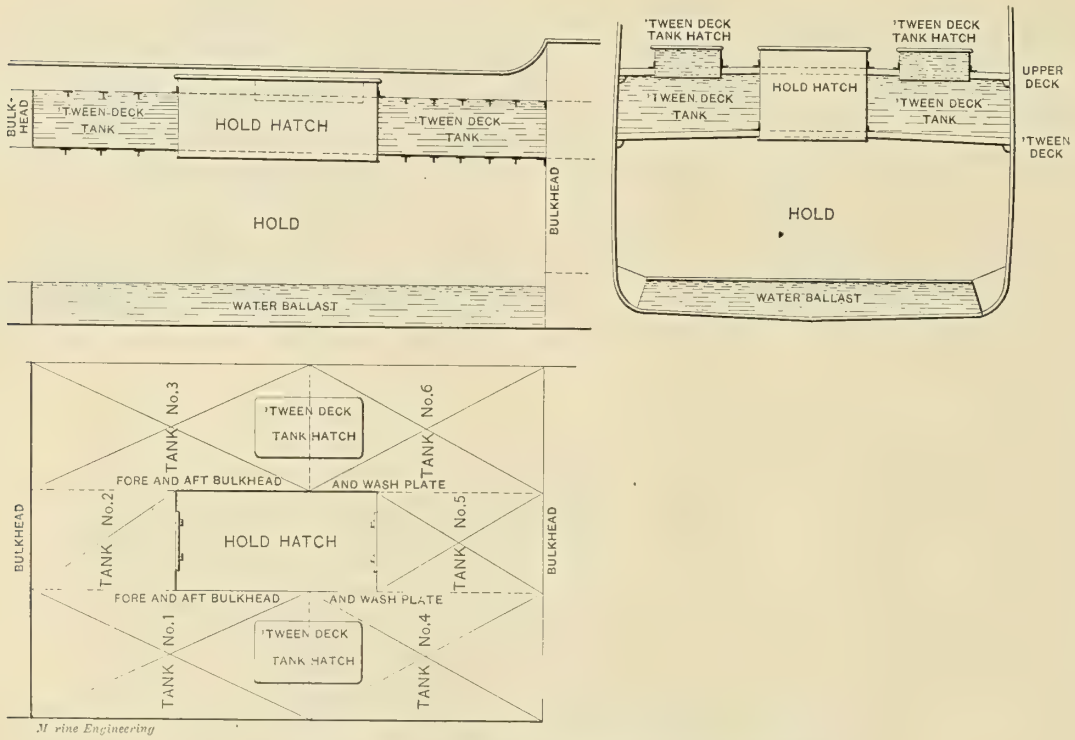
PROPOSED DECK PLANS OF STEAMERS SHOWING TWO ARRANGEMENTS OF BALLAST TANKS.

* Extract from a paper read before the North-East Coast Institution of Engineers and Shipbuilders, December, 1901.

30th, 15 1-2 days on the passage, with an average speed per day of 228.9 knots.

October, 1897.—Left the Tyne on October 11th for Hampton Roads. Arrived there on October 29th. Average speed per day 221.9 knots over a period of 17 days. She had on this voyage 750 tons of sand ballast at 2s. per ton f.o.b., about 400 tons of this being on deck. The quantity of coals and other conditions were the same as previous voyage.

December, 1897.—Left the Tyne December 12th for Hampton Roads and arrived December 31st. Average speed over a period of 18 1-2 days, 194.5 knots. During this passage some exceptionally bad weather was experienced, and innumerable vessels put back in distress and in a more or less disabled condition. The writer does not wish to state any more cases in detail, but he had data of four ships similar to A, during the same work or voyages, viz., to the United States in ballast regularly and home with cargo. The approximate drafts, with sand ballast, were 17 feet 8 inches aft and 13 feet 6 inches forward, ranging down to 16 feet 4 inches aft and 13 feet forward, according to time of the year. The speeds given in ship A are not necessarily given to show the speed of the vessel, but to show the regularity of speed or passages made. Machinery damage was practically nil, there being no shaft breakages or rudder defects during the last four years. After experiences like the above one would wonder at any shipowners allowing their ships to proceed to sea insufficiently ballasted and with such absurd drafts as 12 feet 3 inches aft and 8 feet 6 inches to 10 feet 3 inches forward. On ships of the above types, class and dimensions, the writer is not necessarily advocating sand ballast, but ballast in any shape or form according to the exigencies of the case. Furthermore, he is aware of the fact that some shipowners are now having a special deep tank in the hold immediately aft of the engine room bulkhead. Others again are, he believes, having ballast tanks arranged in the side tanks as advocated by Mr. A. McGlashan in his paper read before this Institution in 1898, or in tanks 'tween decks. The writer does not advocate any special form or means of ballasting steamers, but he does wish to draw attention to the vast amount of damage done to the modern tramp steamers generally, and their machinery in particular, due to the want of sufficient ballast and to the general unmanageableness of the vessels when not answering their helms and falling off their courses into the trough of the sea, to say nothing of the great risk of life.



ARRANGEMENT OF TANKS FOR BALLASTING A MODERN TANK STEAMER.

Ballasting ought to be a more prominent feature in the design of the tramp steamer than it is at present, and the extra cost involved would be so comparatively trifling as to be scarcely worth considering. But apparently up to the present time there are still vessels building of the following dimensions:

(a) Length, B. P., 395 feet; beam, 48 feet; depth, molded, 31 feet; Lloyd's highest class; total ballast tank capacity, 1,019 tons. The approximate displacement of this vessel, with all ballast tanks full and 100 tons of coal on board, fully equipped and ready for sea trial, is 4,059 tons. The approximate drafts are 13 feet 6 inches aft, 8 feet 3 inches forward, mean draft 10 feet 10 1-2 inches; tons per inch of immersion at this draft, 37; distance from base line to center line of shaft,

10 feet 6 inches; diameter of propeller, 17 feet 6 inches; vessel designed to carry over 7,000 tons.

(b) and (c) are two sister vessels. Length, B. P., 360 feet; beam, 48 feet; depth, molded, 30 feet 10 inches; deadweight on 24 feet 6 inches, 7,000 tons; total ballast tank capacity, 896 tons; base line of ship to center line of tail shaft, 10 feet 6 inches; diameter of shaft, 15 inches. From these figures it can easily be seen that these two vessels would not have the bosses of their propellers submerged when leaving a continental discharging port for a United Kingdom loading port fully equipped, stored, and with 200 tons of bunker coals on board.

With figures like these it is no wonder we have continual breakdowns and unmanageable ships. To say the least it is a most unsatisfactory condition of affairs in regard to the ordinary tramp steamer of to-day.

ATLANTIC TRANSPORT COMPANY'S STEAM SHIP MINNETONKA.

The Atlantic Transport Company is at present having built four 600-foot vessels for service between this country and London. Two of these are building in Philadelphia, and the other two at the yard of Harland and Wolf, at Belfast, Ireland. The four vessels are to be sister ships in all general dimensions, and the *Minnetonka* here illustrated is one of the Belfast vessels. The general dimensions will be found in the tabulated form at the end of the article. The length over all is 625 feet; beam, 65 feet, and depth, molded, 44 feet. The *Minnetonka* is of the popular intermediate class of vessels for carrying cargo, cattle and first-class passengers. There are five steel decks throughout, and water bottom from forward collision bulkhead to the stern tube bulkhead.

Forward of the boiler room is a deep tank of 883 tons capacity, and aft of the engine room are five deep tanks with combined capacity of 1,208 tons. The water bottom measures 1,563 tons; tanks holding 603 tons supply water for the cattle, and there is also a 40-ton tank for drinking water.

Cargo is worked through nine hatches located along the center line of the ship. At each hatch are two steam winches. Cargo booms are swung from four pole masts and four derrick poles.

The passenger accommodations and officer's quarters are all located in the bridge amidships, and are large and airy throughout. Stalls for 804 head of cattle are built under the shelter deck. It has been the experience of all those who cross on this type of steamer that the cattle are in nowise objectionable to the passengers.

The ship is propelled by two sets of quadruple expansion, 4-cylinder, 4-crank engines. The sequence of cylinders is, from forward aft, high pressure, second intermediate, low pressure, first intermediate. Piston valves are fitted to all cylinders except the low pressure, which has a flat double-ported slide valve. Each cylinder is a separate casting, and is supported by cast iron box columns, the condenser being cast in the outboard columns. The bed plates are also cast iron and of box section.

The air, bilge and sanitary pumps are driven by levers from the first intermediate crosshead. The shafting is of mild ingot steel, the crank shaft being 18 inches diameter, propeller shaft 18 1-4 inches diameter, and intermediate shafting 17 inches. The crank shaft is of built-up interchangeable sections, set at angles according to the Yarrow-Schlick Tweedy system for the reduction of vibration. The indicated horse power of both engines is estimated at 11,000 when running at 75 revolutions per minute.

The propellers are three bladed and of sectional type, with cast iron boss and manganese bronze blades. The diameter is 18 feet 6 inches, and pitch, 23 feet 6 inches.

Steam is supplied by four double end and four single end boilers, equipped with Howden's forced draft system. The dimensions of the boilers are given in the accompanying table. The air is supplied to the boilers by three fans. There is also one fan for ventilating the stoke hold.

There are four feed pumps of the Weir type with automatic control. There are also two auxiliary feed and general service duplex pumps of the Admiralty type made by the shipbuilders. The fire and fresh water pumps supply deck service and sanitary tanks with salt water, and the cattle tanks with fresh water. There is a centrifugal circulating pump for each main engine, and one for the auxiliary condenser which is used in port, and which receives steam from the winches. These centrifugals, together with the auxiliary condenser and air pump, are made by the shipbuilders. An evaporator of 50 tons capacity, a distiller of 5,000 gallons capacity, and a feed water heater are also supplied.

The electric lights are operated by three direct connected engines of 25 kilowatts capacity.

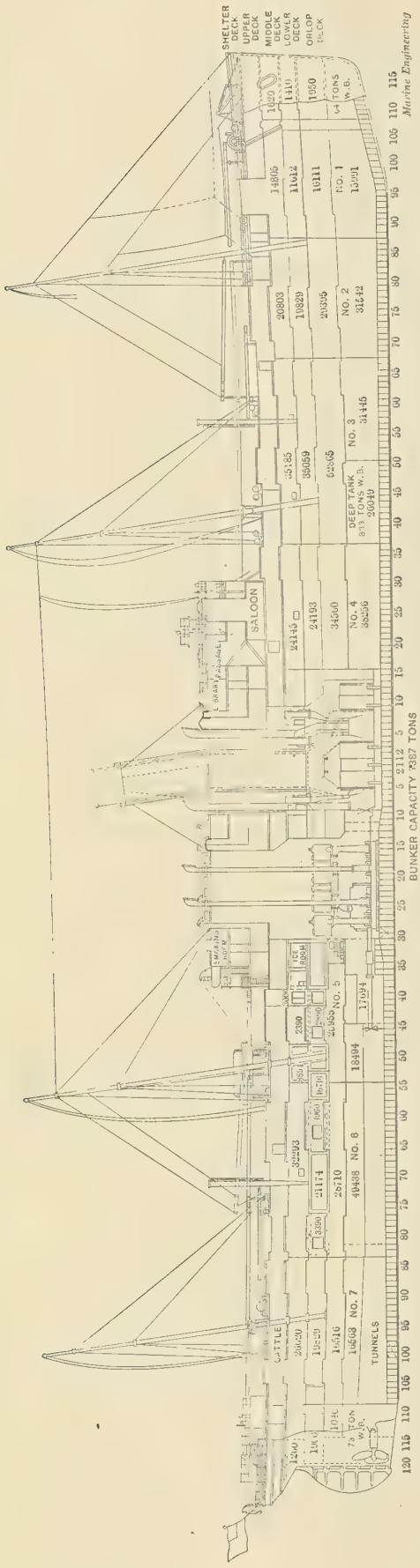
There are all together about 56,000 cubic feet of insulated chambers for the preservation of chilled beef, butter, etc., and for the carriage of ship's stores. These are cooled by the carbondioxide system of refrigeration, the brine being circulated through pipes in the chambers. The refrigerating machine is located in the engine room between the thrust blocks.

The steering gear is made by the shipbuilders of the Wilson and Prince design, and is located in the house aft, with the gear directly connected to the quadrant. There are two engines on sliding beds, each of sufficient size to steer the ship.

Shipbuilding Returns.

Returns to the Bureau of Navigation show that during the first nine months of the current fiscal year, ended March 31, 1902, there were built in the United States and officially numbered 949 vessels of 245,068 gross tons. For the corresponding period of the previous fiscal year the figures were 753 vessels of 246,973 gross tons. These figures do not include canal boats and unrigged barges.

A gain of about 8,000 tons on the Atlantic seaboard is offset by losses of about 5,000 tons on the Lakes, 3,000 tons on the Pacific, and 2,000 tons on Western rivers. Of the nine months' construction only 57 vessels are over 1,000 gross tons each, aggregating, how-



SECTIONAL ELEVATION OF THE STEAMSHIP MINNETONKA, SHOWING THE CAPACITY OF HOLDS IN CUBIC FEET

NAME—Minnetonka. NATIONALITY—British. TYPE—Intermediate Freight and Passenger.

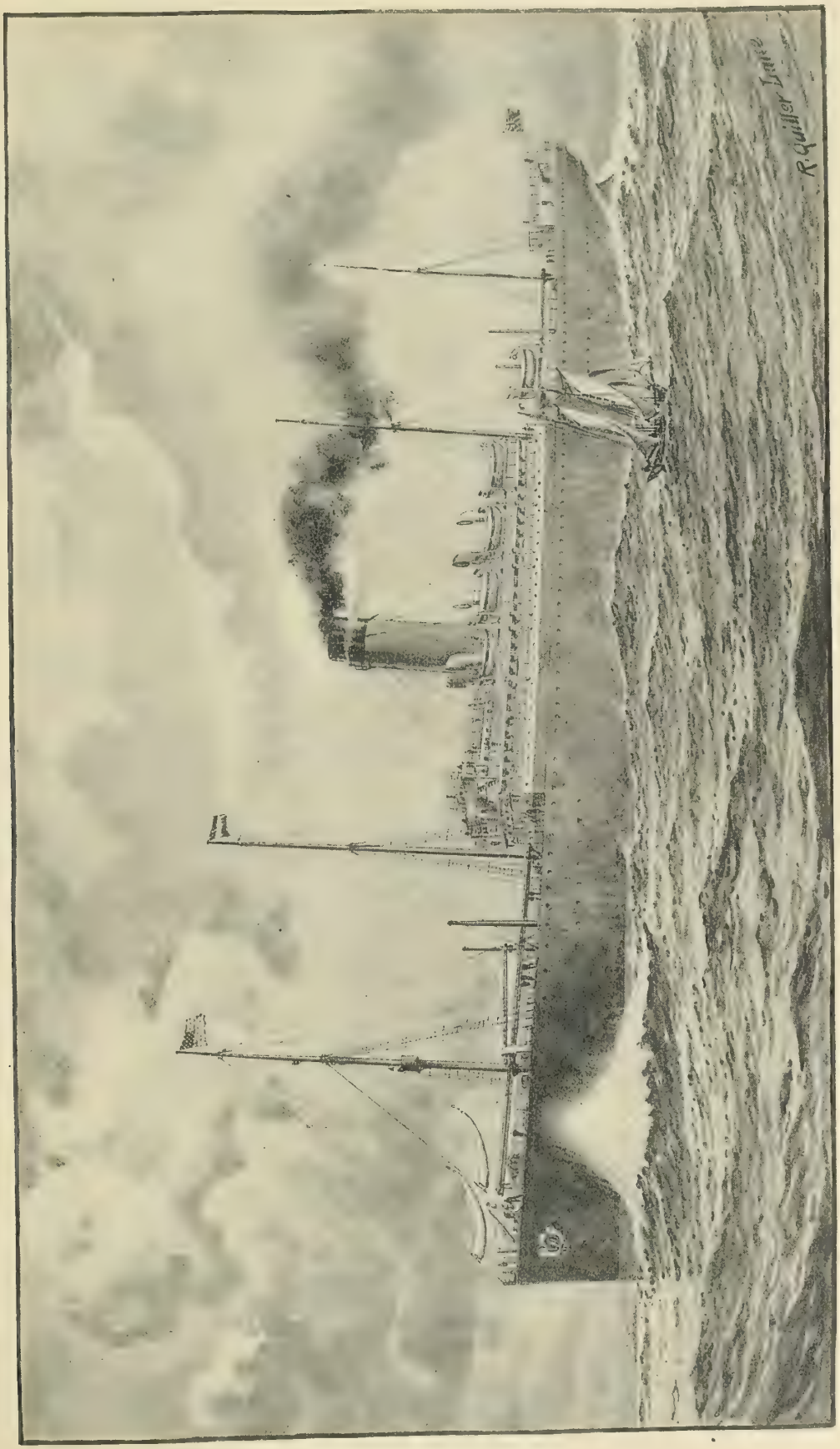
LAUNCHED—1901. BUILDERS—Harland and Wolff.

Length over all	625 ft.	Type	4 cyl. quad. expansion 4-crank
" between perps	600 "	Cylinder diameters	30, 43, 63, 89 in.
Beam	65 "	Stroke	60 "
Depth molded	44 "	Designed R. P. M.	75
Load draft	33 ft. 2 in.	" I. H. P.	11,000
Corresponding displacement	26,530 tons	" speed	16 knots
Dead weight capacity	13,610 "	Condens. surf	13,300 sq. ft.
Coal bunkers	1,890 "	Balance	Yarrow-Schlick-Tweedy
Tanks		Valves	Piston on 3 cylinders
Forward deep tank	883 "	**Boilers,** numbers	4 single, 4 double-end
5 deep tanks aft	1,208 "	Pressure	214 lbs.
Fresh water for cattle	603 "	Diameter	14 ft. 5 in.
Drinking water	40 "	Length, double-end	19 " 1 "
Water bottom	1,569 "	" single-end	11 " 0 "
Total capacity of tanks	4,303 tons	Furnaces, single-end	3
Gross tons	13,401 tons	" double-end	6
Net tons	8,651 "	Diameter of furnaces, internal	4011 ins.
Propellers, No. of blades	3	**G. S.** total	642 sq. ft.
Diameter	18 ft. 6 in.	**H. S.** total	26,336 "
Pitch	23 " 6 "	Draft	Howden
Material	Cast iron boss bronze blades	**H. S.** ÷ **G. S.**	41.02
Engines, number of	2	**H. S.** ÷ **I. H. P.**	2.39
		I. H. P. ÷ **G. S.**	18.69

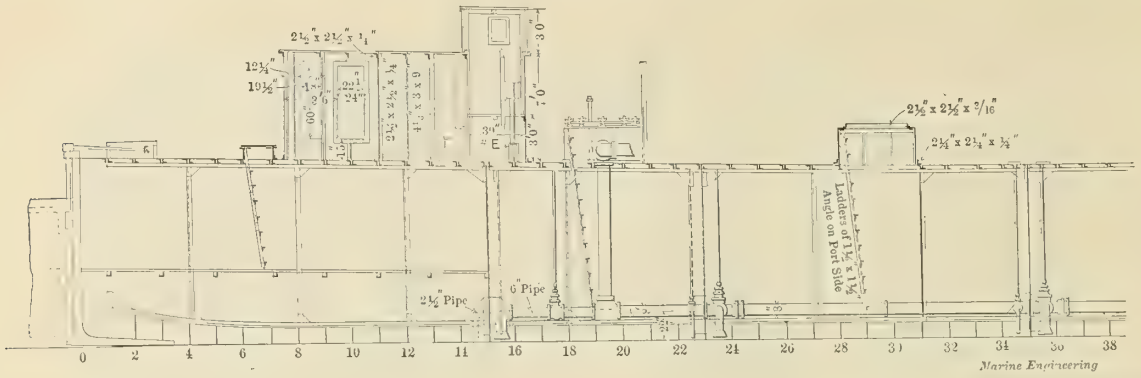
ever, 169,566 tons; or 70 per cent. of the total tonnage. Of these large vessels the Great Lakes have built 22 steel steamers of 84,323 tons. Two of these, *Watson* and *Buckman,* of 1,820 tons each, are banana steamers for West Indian trade; one, *Hugoma,* of 2,182 tons, is for the Porto Rican trade, and one, *Minnetonka,* of 5,270 tons, is to be cut in two to pass the Canadian canals, and then rejoined for ocean trade.

The seaboard has built 10 steel steamers of 41,204 tons, of which the largest is *Korea,* 11,276 tons, a Pacific Mail steamer for trade from San Francisco, via Honolulu to Hongkong, with possible extension to the Philippines. One, *Nevadan,* 4,408 tons, is for the New York-Hawaiian trade; one, *Pathfinder,* 2,792 tons, is for the Porto Rican trade; one, *J. M. Guffey,* 2,520 tons, is for the Texas petroleum trade. The others are for the usual coasting trades.

The advanced construction of vessels launched, or soon to be launched, indicates that the total construction for the year will somewhat exceed that of the fiscal year 1901. Contracts for new work are, however, less than a year ago.



STEAMSHIP MINNETONKA, BUILT BY MESSRS. HARLAND AND WOLFF FOR THE ATLANTIC TRANSPORT LINE.


2½" x 2½" x ¼"
12¼"
19½"
2½" x 2½" x ¼"
4" x 3" x ⅜
3'0"
1'0"
3'0"
"E"
2½" x 2½" x 5/16"
2½" x 2¼" x ¼"
Ladders of 1¼" x 1¼" Angle on Port Side
2½" Pipe
6" Pipe
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38
Marine Engineering

LONGITUDINAL SECTION

OIL BARGES.

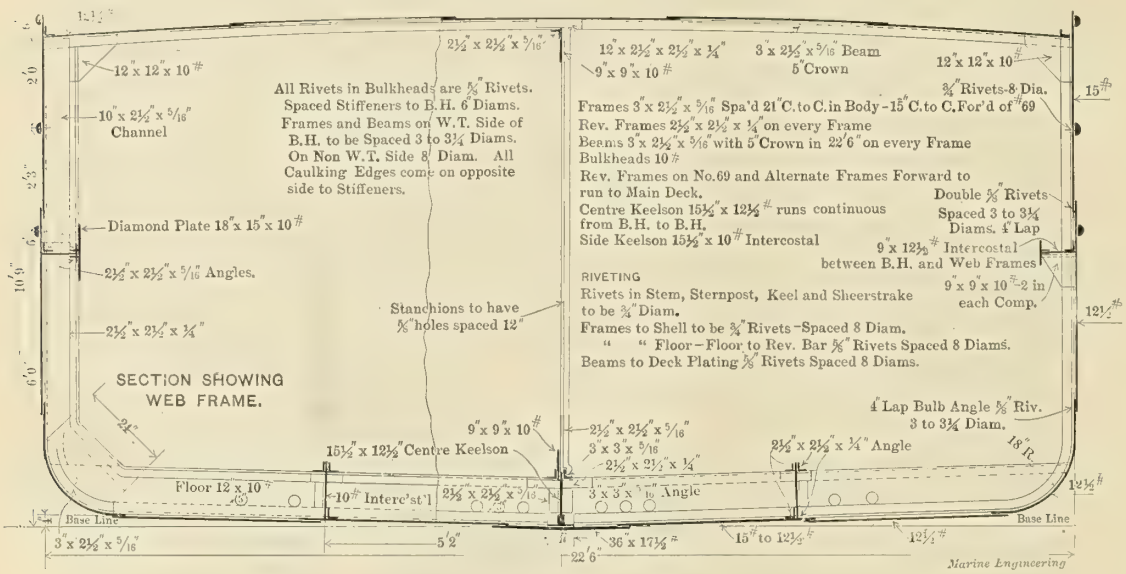
BY EADS JOHNSON.

With the recent development of the Texas oil fields, the question of transportation and distribution of oil has atracted considerable attention. A brief sketch of the construction of oil barges may be of interest to prospective investors in oil and builders of oil carrying craft.

The essential features connected with the construction of steel barges and steamers for carrying oil, occur, requires reaming and the use of a large size rivet. To quote Thomas Walton in his recent edition, "Steel Ships and Their Construction": "Bad riveting spells *doom* to an oil carrying vessel." This may not be too seriously considered, for where there is leaking oil, there is an explosive gas that is very dangerous. As a matter of fact 90 per cent. of the accidents to oil carrying ships has been traced to bad riveting.

VENTILATION.

Oil gas is very inflammable and should be removed

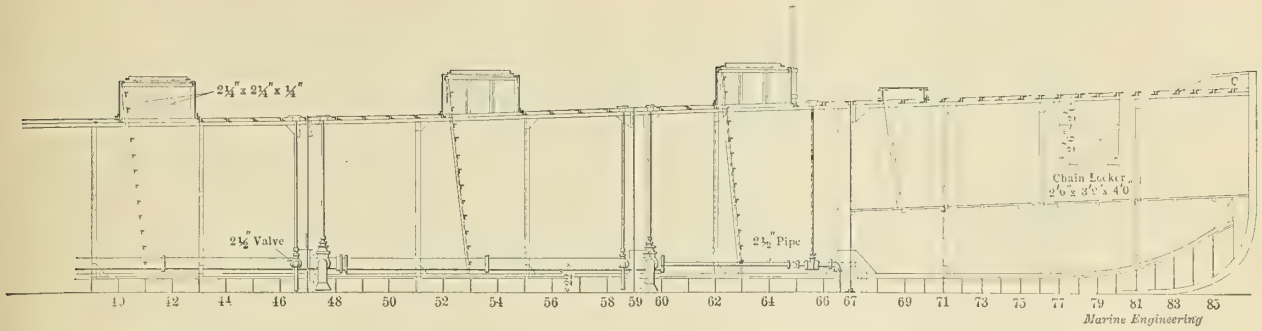

12" x 12" x 10#
10" x 2½" x 5/16" Channel
All Rivets in Bulkheads are ⅞" Rivets. Spaced Stiffeners to B.H. 6 Diams. Frames and Beams on W.T. Side of B.H. to be Spaced 3 to 3¼ Diams. On Non W.T. Side 8 Diam. All Caulking Edges come on opposite side to Stiffeners.
Diamond Plate 18" x 15" x 10#
2½" x 2½" x 5/16" Angles.
2½" x 2½" x ¼"
SECTION SHOWING WEB FRAME.
Stanchions to have ⅞" holes spaced 12"
2½" x 2½" x 5/16"
12" x 2½" x 2½" x ¼"
9" x 9" x 10#
3 x 2½" x 5/16" Beam 5" Crown
12" x 12" x 10#
¾" Rivets-8 Dia.
15#
Frames 3" x 2½" x 5/16" Spa'd 21" C. to C. in Body - 15" C. to C. For'd of #69
Rev. Frames 2½" x 2½" x ¼" on every Frame
Beams 3" x 2½" x 5/16" with 5" Crown in 22'6" on every Frame
Bulkheads 10#
Rev. Frames on No. 69 and Alternate Frames Forward to run to Main Deck.
Centre Keelson 15½" x 12½# runs continuous from B.H. to B.H.
Side Keelson 15½" x 10# Intercostal
Double ⅞" Rivets Spaced 3 to 3¼ Diams. 4" Lap
9" x 12½# Intercostal between B.H. and Web Frames
9" x 9" x 10#-2 in each Comp.
12½#
RIVETING
Rivets in Stem, Sternpost, Keel and Sheerstrake to be ¾" Diam.
Frames to Shell to be ¾" Rivets - Spaced 8 Diam.
" " Floor - Floor to Rev. Bar ⅞" Rivets Spaced 8 Diams.
Beams to Deck Plating ⅞" Rivets Spaced 8 Diams.
4" Lap Bulb Angle ⅞" Riv. 3 to 3¼ Diam.
18" R.
9" x 9" x 10#
15½" x 12½" Centre Keelson
2½" x 2¼" x 5/16"
3" x 3" x 5/16"
2½" x 2½" x ¼"
2½" x 2¼" x ¼" Angle
3 x 3 x ⅜ Angle
Floor 12 x 10#
10# Interc'st'l
2½" x 2½" x 5/16"
12½#
Base Line
Base Line
3" x 2½" x 5/16"
5'2"
36" x 17½#
15# to 12½#
12½#
22'6"
Marine Engineering

MIDSHIP SECTION OF AN OIL BARGE.

over and above the necessary requirements in constructing steel ships for general purposes, may be briefly stated. Assuming that oil is to be carried solely in bulk, the practice of which is universal, special attention to the riveting, stiffening and ventilation is necessary in order to avoid serious trouble.

RIVETING.

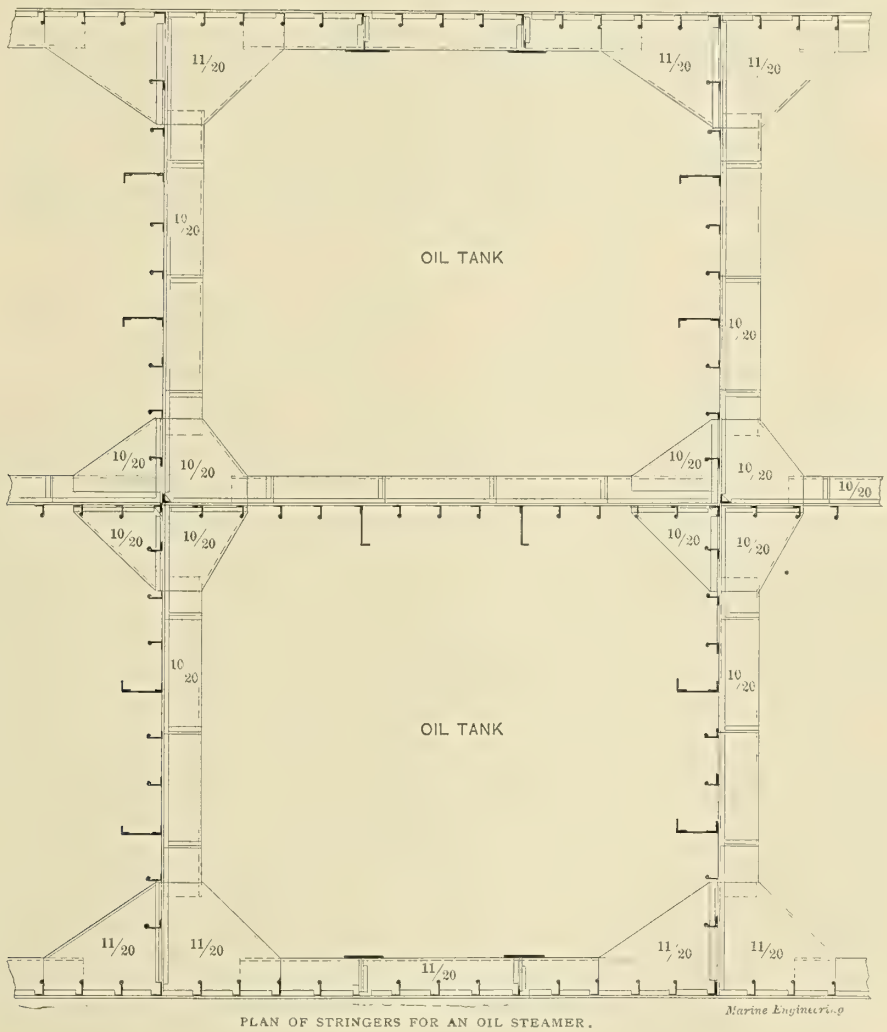
Oil tightness requires closer spacing and more efficient riveting than does water tight work. The spacing for oil tight work, by the best authorities, is 3 to 3 1-4 diameters, using pan head rivets driven countersunk. Drifting a hole to get in the rivet is bad practice, and first-class work, where blind or partly blind holes wherever found. Very little danger may be apprehended when the tanks are full of oil. Expansion hatches are provided for every tank, as shown in the longitudinal section above, and the level of the oil is carried up into these. These hatches perform a double service; first, in lessening the straining of bulkheads or sides when the vessel is in a sea way and the liquid would naturally swash from one side to the other if the compartment were not filled to the crown of the beams; and second, it leaves a smaller surface of oil from which gases may arise. As the density of oil gas is greater than that of air, it will settle and when the tanks are empty, or being emptied in port, this gas



OF AN OIL BARGE.

should be removed by suction ventilation. The oil suction pipes may be used for this purpose after the oil has been discharged.

can be used to advantage at these times in connection with the aforesaid method of using the oil suction pipes for ventilation purposes.

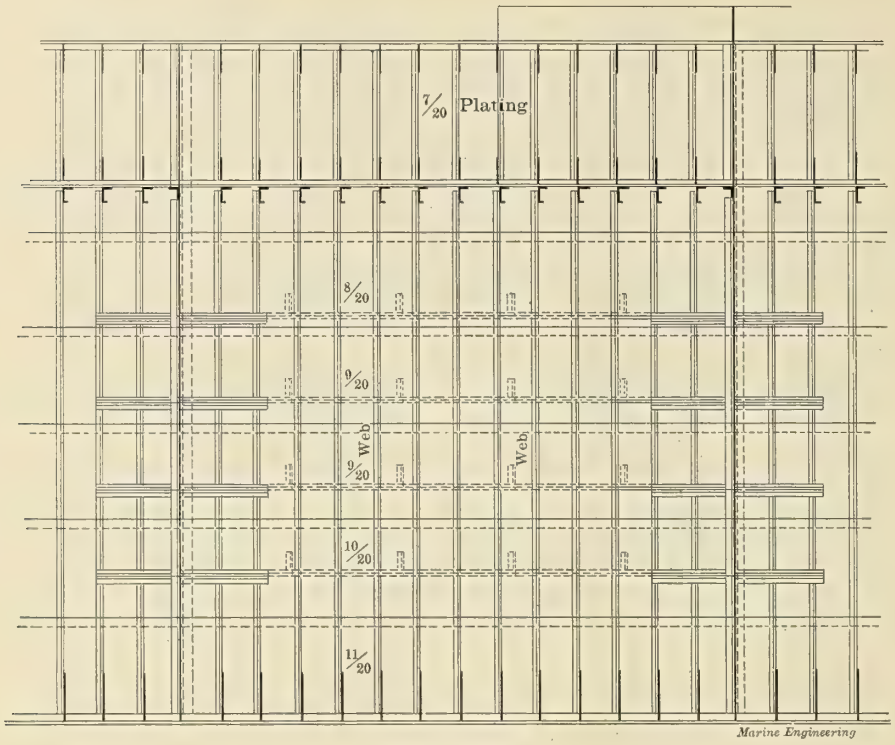


PLAN OF STRINGERS FOR AN OIL STEAMER.

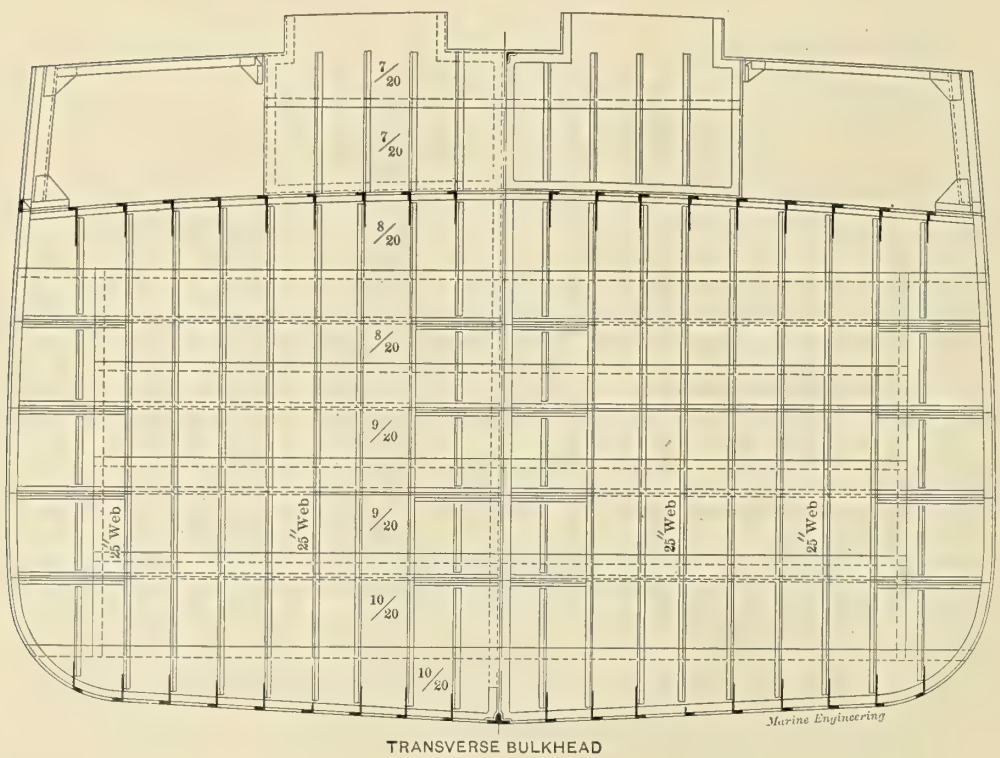
Loading and unloading are the most dangerous times, and ventilation by means of fans, although desirable, is hardly necessary or advisable, owing to extra cost of operating high speed fans, the care and maintenance of same. The familiar canvas wind sails

STIFFENING.

Ocean-going barges and steamers require extra stiffening longitudinally and transversely owing to the enormous pressure brought to bear upon the dividing bulkheads. Transverse bulkheads should be spaced

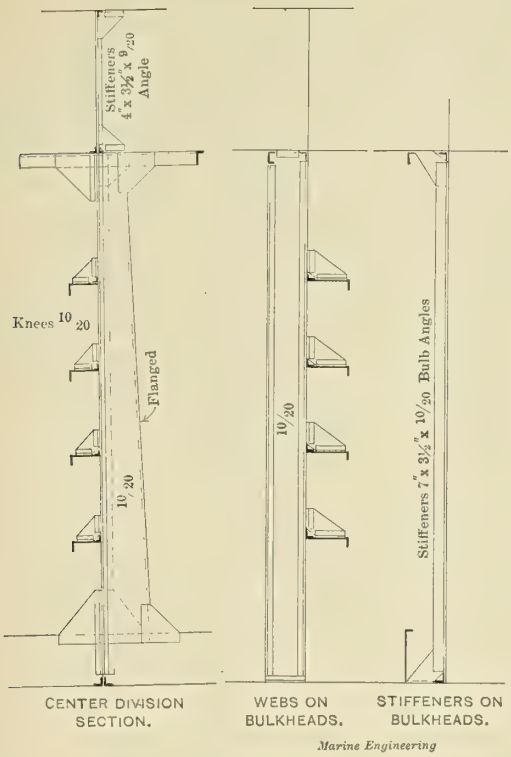


CENTER DIVISION



TRANSVERSE BULKHEAD

BULKHEAD CONSTRUCTION ON AN OIL STEAMER.



not more than 28 feet with one or more web frames within these spacings according to requirements, and a continuous longitudinal center line bulkhead is desirable extending vertically from keel to deck, and from stem to stern brought up at the ends.

The construction of oil barges recently built at one of the shipyards is shown in the accompanying drawings. On pages 230, 231 are given the midship and longitudinal sections of an oil barge built for coastwise and inland service to carry about 150,000 gallons. The barge is constructed of mild steel throughout, divided by six transverse bulkheads forming five tanks. Above each compartment is an expansion hatch. The principal dimensions are: Length, 150 feet; beam, 21 feet; depth, 10 feet 9 inches; and, draft when loaded, 9 feet. There are no pumping facilities on board, as the barge is for a special service in which there are pumping stations established at the docks at both ends of the route.

On pages 231 to 233 are shown the bracketing and stiffening of an oil steamer with carrying capacity of about 2,500,000 gallons. The ship will be 450 feet long over all, 51 feet beam and 30 feet depth. Bulb frames and stiffeners are used and have been universally adopted for this class of work. The necessary and seemingly large amount of stiffening shown in these drawings may be accepted as an example of the best modern practice. Several oil barges are at present under construction in the various yards, both on the coast and Lakes. One of these new barges will be 375 feet length over all, 360 feet on water line, 50 feet molded beam, and 28 feet 6 inches molded depth, giving a capacity of 2,000,000 gallons on 24 feet draft. On this barge the distance of transverse bulkheads is 28 feet. These are cut in way of the center line bulkhead, which is continuous throughout the cargo space and tapers down to the height of the center keelson fore and aft of the cargo space. There is a web frame in each space at the shell, also one at the center line bulkhead abreast of it and one on each transverse bulkhead on either side of the center line bulkhead. The side stringers, of which there are three on the shell side of the tanks, and four to the center line bulkhead, are intercostal between bulkheads and webs, the webs being continuous.

The completion of these vessels will mark the first of such large capacity built in American shipyards.

REFRIGERATION ON SHIPBOARD.—I.

BY E. N. PERCY.

The object of these articles is to emphasize the fact that a higher standard of refrigerating machinery ought to be required than at present for marine service; that it ought to be rigidly inspected and licensed; that it is a dangerous and important part of the machinery; and that engineers in charge ought to be closely examined in the subject, and be of unquestioned ability.

The first article will deal with the troubles, repairs and many actual breakdowns due to inferior machinery of this class. The second, with the design and economical operation of the machinery, and the standard of men that should be required. The last will deal with the design and systematic operation of the cold storage, brine system, ice tanks and details; also will touch upon ways in which the steward and butcher can save many pounds of coal used by the plant.

On a certain large ship chartered by the United States Government to take troops to Manila, the engine department had been supplied with a typical light weight refrigerating machine, of the ammonia compression type, "especially built for marine service." The expansion valve was a cheap affair, consisting of a valve with a coarse thread, and cone seat, and an oil chamber below, with a drain cock at the bottom, as in Fig. 1. As soon as the machine was started it was found that the valve could not be regulated closely enough. The machine would first be running wet, then dry. It was arranged as shown in sketch, with a long lever, at the end of which was a circular strip of steel, properly indexed. With this, a fine, accurate adjustment could be obtained.

The piping had been put in carelessly, and through careless attendance in the main engine room hot water was turned through the condenser of the refrigerator. The pressure of the ammonia went up to four hundred pounds in a few seconds, in spite of immediate efforts to correct the trouble. All the joints sizzled, and the compressor came to a dead stop. The brine circulating pump next gave trouble. It was a cheaply gotten up pump, and had a patent water piston made up of sectional rings set out by screws. This piston got to sticking, and finally collapsed. We repaired this by making a new, soft packed piston out of two plates of steel, with soft packing between.

The discharge of the compressor led into an oil separator, as the compressor operated with oil injection.

The separator was merely a piece of 6-inch gas pipe four feet high, as in Fig. 2. The oil always staid in the form of foam, and was carried over, making trouble in the condenser. Also, it should collect in the expansion valve, where it was very unpleasant to tap it off because of the odor. If the valve were opened to blow it through to the coils, the adjustment was lost, the equilibrium of the system upset, and the coating of oil inside the expansion coils decreased the efficiency, and caused much irregularity.

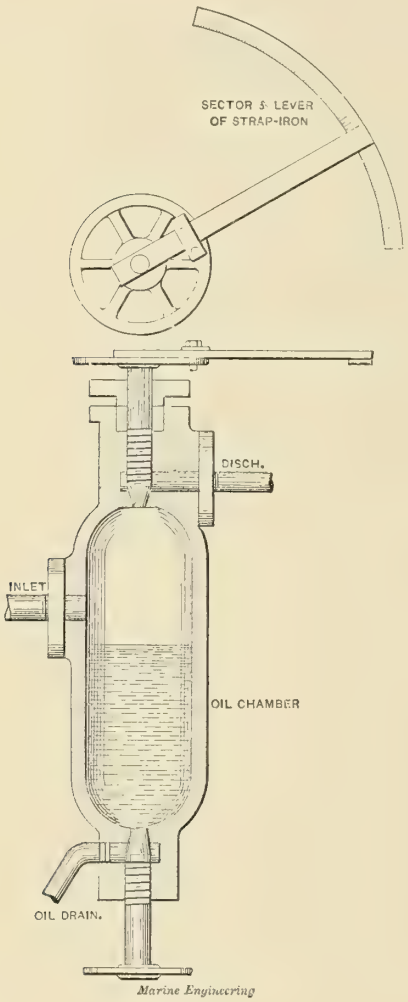


FIG. 1.

On another ship the pipe to the expansion valve did not extend to the surface of the liquid in the reservoir, and after arriving at a foreign port with provisions spoiled, it cost hundreds of dollars' worth of experimental repairs to find why the machine didn't work. In double-acting compressors, unless the oil seal stuffing boxes are long and solidly designed, they will leak and give ceaseless trouble; particularly when horizontal. On many small plants the separators, supposed to contain lime, caustic soda or potash to absorb water from the ammonia gas, are hard to get at. Many are not supplied with cut-out pipes, necessitating the closing down of the plant to do routine work. This work is painful and dangerous anywhere, and every facility should be provided for dealing with these powerful chemicals.

Many times, in the brine, or in the condenser, or even the jacket water, a white stringy substance will be noticed. This is a sure sign of an ammonia leak under (salt) water, as ammonia, added to salt water

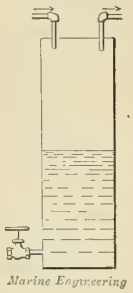


FIG. 2.

causes a rich milky precipitate, as can be easily proven by any one with common washing ammonia and salt water. The reaction is $Na\ Cl + H_4NHO = H_4N\ Cl + Na\ HO$. The sodium forming sodium hydroxide.

Oil injection machines are to be looked upon with suspicion for marine work. Not that their efficiency

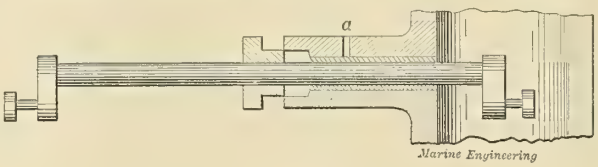


FIG 3.

is questioned, but they have an inherited proclivity for knocking out their cylinder heads, an accident both inconvenient and dangerous, considering the suffocating nature of ammonia gas. One make of machine has the crank shaft extended through a long babbitted stuffing box, with no means of lubrication as in Fig. 3. The babbitt melted out several times on one machine,

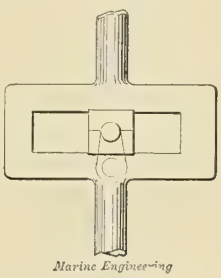


FIG. 4.

then the engineer bored a hole at (a) and put in a compression grease cup, and had no further trouble. This same compressor has a long sliding yoke, instead of a connecting rod, as in Fig. 4. Now a good running compressor should not have greater clearance than 1-32 inch, but this yoke springs so much that the crank pin brasses have to be run very loose, and the difference in efficiency with the larger clearance is quite noticeable.

Other makes have oblique suction and discharge valves. If these are cheaply made, as is often the case, they soon wear elliptical, and leak, giving a great deal of trouble, and causing great waste. One machine runs a short crank shaft, supported on two narrow bearings, with two overhung cranks; the valve is operated by a return crank from the overhung engine crank. The valve stem has no guide except its own stuffing box. This engine has to be stopped to be oiled. As it wheezed and groaned and thumped, and shook the deck, I asked, "What is the matter with it?" out of curiosity, to find out the Irish engineer's opinion. "Sure, sor, an' they allus run an ice masheen thot way." I meekly said, "Is that so?" and retired.

Ordinarily, when a machine needs charging at sea, a cylinder is laboriously carried down from the upper deck. Then, while scantily chocked on the floor, to keep it from rolling, a crazy pipe connection is made, and the ammonia is turned on, with a sure chance of breaking the pipe if the cylinder moves from the rolling of the ship, and not a chance in the world to shut it off, as the valve on the average drum is very hard to get at. There is no weighing, merely a rough guess at the pressures from the gauges.

Very frequently we hear of the ammonia pipe on a ship bursting, and often the ship returns to port, showing how serious an accident this is. Leaky fittings and poor workmanship are common defects in ammonia piping on shipboard. One engineer (?) put in some nice, new galvanized pipe for his ammonia. The way the pressure ran up, and the amount of nameless gases he blew off before his machine would "freeze" was a lesson to him for many days. Another would-be scientist engineer undertook to "neutralize" the odor of some oil he had tapped off, with concentrated sulphuric acid. He couldn't be found when the fireworks were over, and the chief got a new man. These things show the need of men *informed* upon refrigeration, and to whom it is not a science pregnant with mystery.

If an inferior quality of piping is used, the brine will soon corrode it, causing ammonia leakage, and up at the ice house the brine may leak through on to the meat; whereas, the days of "salt horse" are supposed to be done away with, if we can run our refrigerating plants properly. Where drinking tanks are cooled by brine pipes, the distilled water outside and the brine inside will eat away the pipe, the water is salted, and the blame is laid upon the innocent evaporator attendant for allowing the evaporator to flood and prime.

Another point that is not to be ignored when meat is hung closely in a storeroom, and close to the wall, it is possible when the ship is pitching, for an attendant to be severely squeezed against the wall. The writer has had several storeroom experiences in rough weather which were not entirely pleasant.

Several tons of frozen meat swinging around, one hundred pound cakes of ice skating around the floor, to say nothing of buckets, implements, turkeys, vegetables and water, all one great mess, dangerous to life, limb and stomach. With the apparatus usually provided it is difficult and dangerous to draw ice in rough weather. Also, while the cans are out, or being manipulated, much valuable brine is lost by spilling from the ice tank, as the ship pitches. This could be prevented by a by-pass pipe, with a gauge glass on the tank.

The writer had much trouble on one ship with the brine coils in the storerooms. There were two rooms, one port and one starboard. The brine supply was supposed to divide and go to each room, but in rough weather, or when the ship was listed, it would all run to one side, and if choked off by the stop valve that valve needed constant attention to adjust it to every little change of the ship or machine, and in certain positions of the ship, all the brine would run to the ice tank, leaving the pipes empty, except for the small stream supplied by the pump. These pipes were strung around each room in one continuous spiral, without manifolds. The frost would gather so heavily on the first part of the pipe that it could not be scraped off, hence the temperature of the rooms never got below the melting point of ice, and the brine was so warm after coming out that it could not be used in the ice tanks, frequently returning to the machine at a temperature of 45 degrees Fahrenheit. The most of this heat went to make the ice on the first half of the pipes in the storerooms.

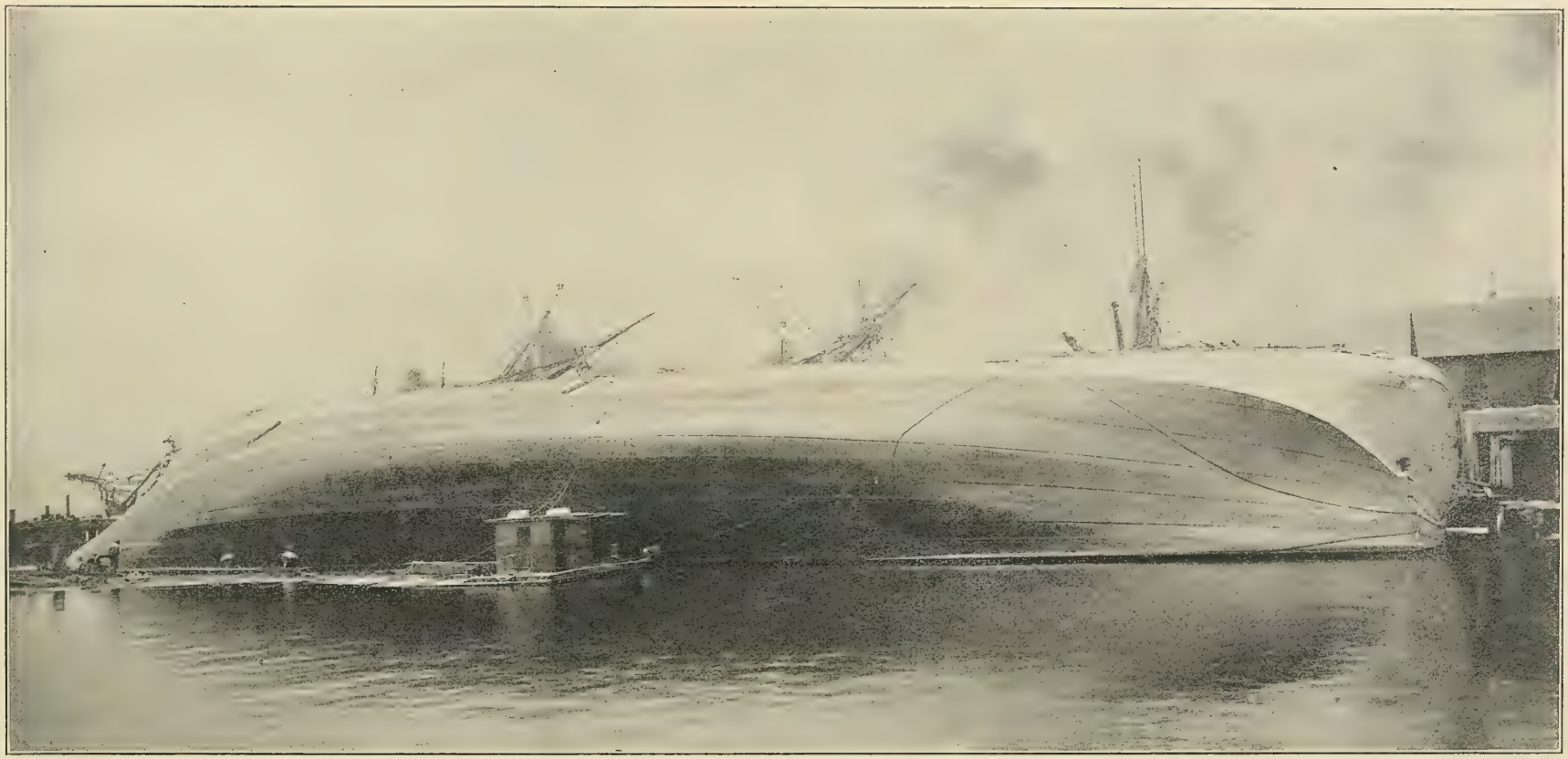
From this, we can justly conclude, I think, that a poor class of refrigerating machinery is used for marine purposes, and we stand in need of solid and economical designs, men skilled in handling them, and laws to enforce this. In this article no mention has been made of the number of people hurt or the inconvenience experienced through failure of apparatus, as the writer does not wish to direct attention to the failings of any particular company or manufacturer.

Careening Ships.

Editor of Marine Engineering:

I was very much interested in seeing in a recent number the illustrations of the New Bedford whaling vessels undergoing repairs, and beg to call to your attention that this method of repairing the bottoms of ships is not confined to the New England ports. At Pensacola, Fla., large and small vessels are frequently repaired in this manner. In fact, the bottoms of so many ships have been overhauled by careening them that it is an ordinary thing to see a large vessel at the wharf lying on her beam ends.

To illustrate the methods used at Pensacola, I am sending you two photographs taken not long ago of the English ship *Yarkand,* which went ashore in the Gulf during a gale and was brought for repairs to Pensacola. Strong backs were placed from the main and foretops to the gunwale and then a block and fall were led from the wharf to each of the tops, and the lines carried to a small hoisting engine, which is seen on the dock. Hose from suction pumps was led to the hold in case the ship should take water, and, when all was ready, the hoisting engines were started and down went the ship. Sometimes ballast is used to facilitate this operation. When the vessel is all over, the keel is entirely out of water, and the workmen, from rafts and staging brought alongside, can get at any part of the bottom plating.

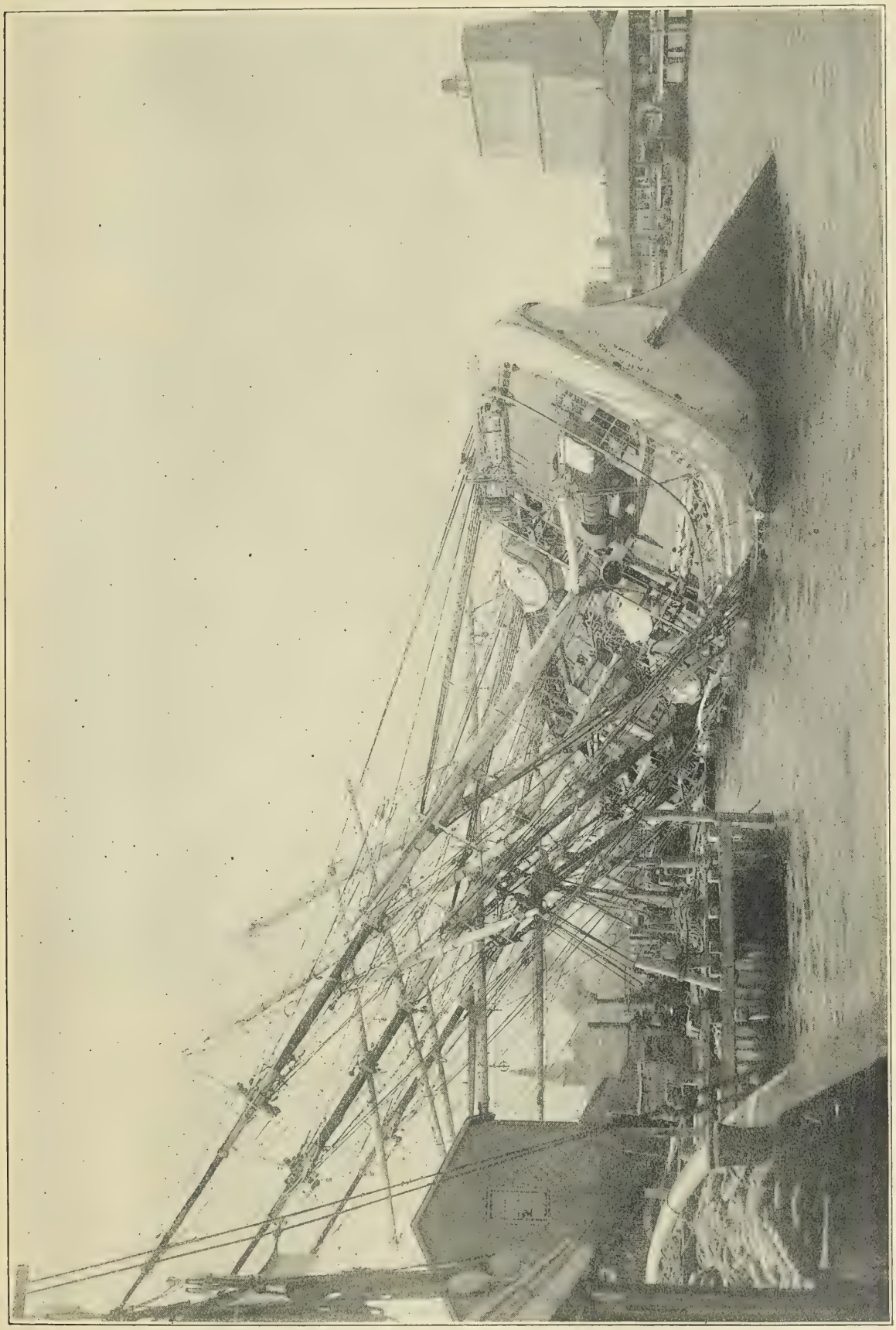


SHIP YARKAND CAREENED FOR REPAIRS AT PENSACOLA, FLA.

In the case of the *Yarkand* a damaged plate was removed and replaced while the ship was in this position. The equipment on the dock is complete and so arranged that a vessel can be hauled over and repaired in very short order. This practice, instead of decreasing, is increasing, and, although there is a small marine railway at this port, many of the repairs to ship's bottoms are performed after "docking" in this manner.

H. D. F.

The Steamer City of Pekin.—On March 19th of the present year the steamship *City of Pekin* arrived at San Francisco, completing her one hundred and sixteenth round trip to Hong Kong. The first trip was made in February, 1875. The only serious breakdown met with was once when the ship was eleven hundred miles out from San Francisco, bound in. She sailed all the way in and arrived only 11 days late. Her engines have made since starting in the service 146,860,094 revolutions; she has steamed 1,594,519 miles and 345,482 tons of coal have been burned under the boilers. The *Pekin* is now on her last voyage in the San Francisco-Hongkong trade, for, by the time she returns to this country, the new ship *Korea*, building at Newport News for the Pacific Mail Steamship Company, will take her place on the line. The *Pekin* was built at Roaches' shipyard, Chester, Pa., in 1874. Her sister ship, the *City of Tokio*, was lost on the Japanese coast soon after she came out.



DECK VIEW OF STEEL SHIP YARKAND CAREENED AT PENSACOLA, FLA., FOR REPAIRS TO HER BOTTOM.

Oil Fuel Burning on the Pacific Coast.

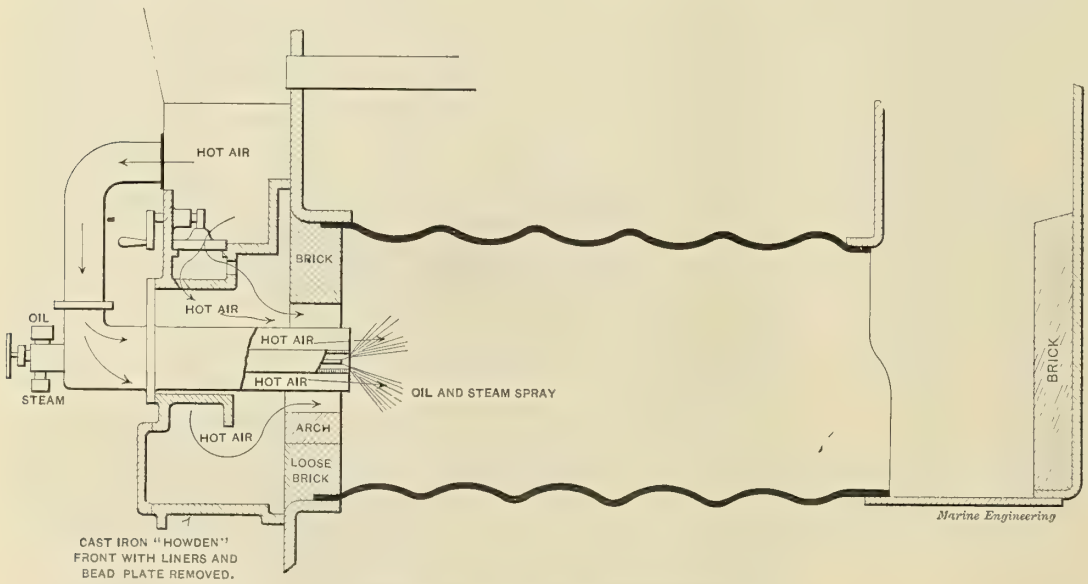
The *Journal* of the American Society of Naval Engineers contains an interesting letter on the above topic and from which we make the following extracts:

Bakersfield oil is sold at 85 cents per barrel of 42 gallons, delivered. It is an average of 16 degrees Baume with an asphaltum base and equally limpid at 150 degrees Fahrenheit, but cools at about 40 degrees, enough to prevent it passing through a 3-8-inch pipe with an ordinary funnel. If heated in pipes or tanks at about 200 degrees, it tends to separate and deposit carbon on the oil side of the pipe, and will also do so when heated to about 160 degrees if the heat applied has a temperature of about 150 pounds steam pressure. Therefore, any heating to make this oil fluid for pumping is best done by using exhaust steam or warm water.

In his opinion sufficient space for combustion must be secured before the gases impinge upon any surface.

This burner requires about 4.1 per cent. of the evaporation for the fan power, oil heating and steam jet. Some of the jet burners require 8 per cent. If the apparatus was left in the hands of an ordinary fireman this figure increases to 12 per cent.

Another burner used with an air pressure of about 9 ounces with no steam jet is briefly described. The air enters through a flattened nozzle at the rear, where it is controlled by a damper and passes partly over an internal tray with a wide lip with sawtooth edge over which the oil drops and is swept by the incoming air into the furnace. This is gas making in a short time and distance, and, when adjusted, gives perfect combustion at a low cost of spray.



FUEL OIL BURNER ATTACHED TO SCOTCH BOILER

Applying it to a marine boiler which was already fitted with Howden's forced-draft, the grates and bridge walls were removed and a brick wall built against the back connection sheet as a protection to the stayholt nuts. The burner was inserted in the front of the furnace and the forced-draft air ducts were used as they existed, with the addition of a pipe 6 inches in diameter from hot air duct directly to ell on burner.

After trying various burners, the one here illustrated was found best adapted to this system of forced draft. It gives a large volume of flame, which, it has been found, does not subject the boilers to the risk that jet burners have.

The writer states that, in his opinion, it is a mistake to spray the oil on a brick wall under the supposition that the wall will be hot enough to aid in raising the temperature of the flame in the furnace. With heavy oils, if combustion is not completed before an impact with the wall, a carbonaceous deposit, something like coke, will be deposited on the wall, which will burn slowly, after the oil supply is cut off, in a strong blast.

The points to be considered in fitting up oil furnaces are: Constant pressure of an oil supply at a temperature of about 170 degrees; the pump discharge should have loaded escape valve connection to the suction.

Gas traps in the piping should be carefully avoided as the gas will cause the flame to flicker and sometimes put it out. A settling tank should be provided to remove the water from the oil, the water being drawn off from the bottom of the tank; all valves and joints must be perfectly tight. The cock, with triangular hole in the plug, is a better regulator than needle valves for oil. The oil supply for combustion should surround and enter from behind the point of the burner and not be admitted all over the full width of furnace front.

Where a battery of boilers is in use, the tendency of the fireman is to get one or two boilers evaporating more than the others. To obviate this, fit thermometers in the base of smokestack or upper part of breeching, and instruct the men to try to keep the temperature as nearly equal as possible. Also, when steam jets are used insert a nipple between valve and burner, this

nipple having a hole in it just large enough to pass steam suited to the requirements of the particular burner.

Among the many patented burners there is little difference in their economy, and all depend for their economy on the cost of the spraying, which is too often left to the control of the firemen.

The results of a seven-hour test on a three-furnace Scotch boiler fitted with one Sunlight oil burner on each furnace are as follows:

Boiler, steam heating surface ..... 1,700 sq. ft.
Howden system, air heating surface..... 1,350 " "
Oil burned per hour..... 682.7 lbs.
Evaporation from and at 212 deg. per lb. oil..... 14.7 "
Steam used for atomizing oil...2.5 per cent.
" " " heating oil. ... .3 " "
" " " blower..... 1.3 " "

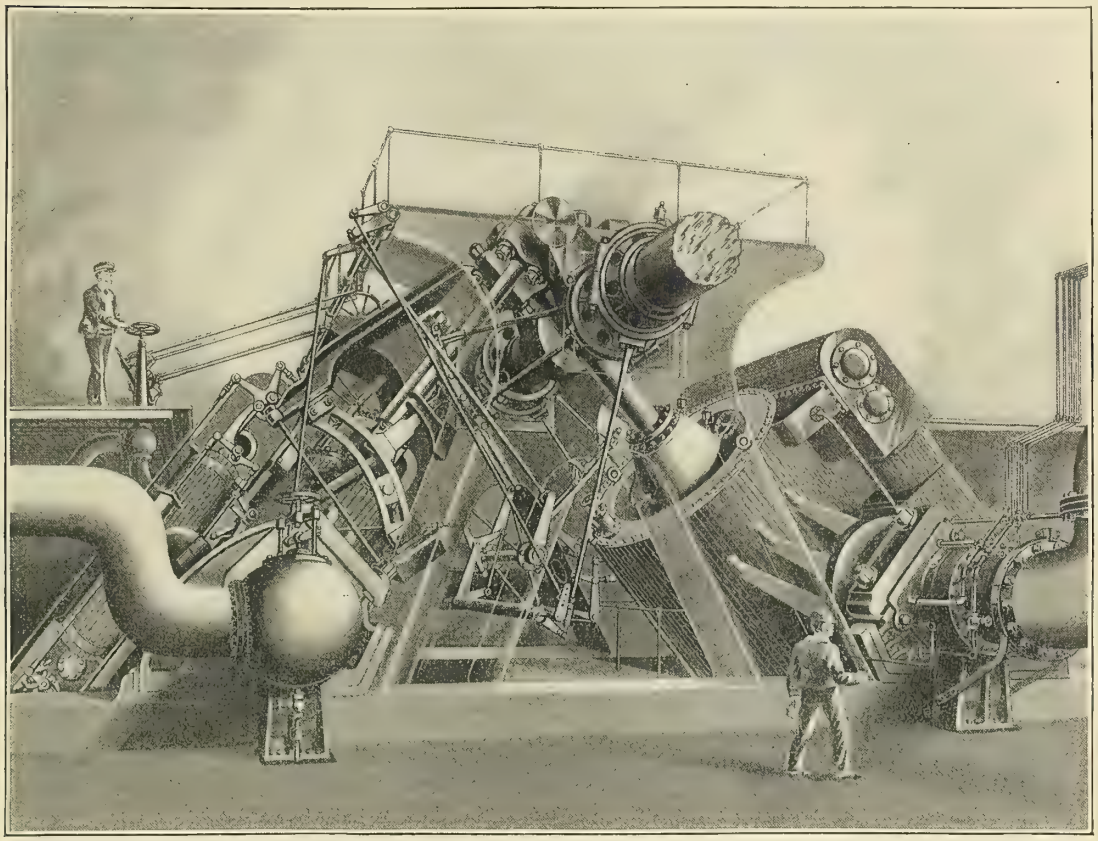
Total steam used in combustion..... 4.1 per cent.
Net water evaporated per lb. oil..... 14.1 lbs.
Total evaporation per square foot heating surface..5.9 "
Temperature of smokestack..... 419 deg. F.
" " air for combustion ..... 250 " "
" " oil ..... 136 " "

In a second test, when 983.8 pounds of oil were burned per hour, the total evaporation per pound of oil was 14.3, and the temperatures were: Smokestack, 485 degrees; air for combustion, 275 degrees; oil, 157 degrees.

Liquid Fuel.—The Oceanic Steamship Company and many other Pacific vessel owners are burning fuel oil on their steamers.

Engines of the Steamboat Connecticut.

The side wheel steamboat *Connecticut* is again in service on Long Island Sound, and for the last twelve months has been running between New York and Providence. Unusual interest is manifested in this boat because of the engines which are of the compound oscillating cylinder type. The *Connecticut* was built in 1889. For several years accidents to the machinery of a greater or less extent were met with, until, finally, one night while on a regular trip, one of the piston rods of the low pressure cylinder snapped off about four feet from the crank, and demolished the cylinder. The boat was laid up and not repaired until recently, when the contract was given to the W. and A. Fletcher Company, of Hoboken, N. J.



COMPOUND OSCILLATING ENGINES OF THE STEAMBOAT CONNECTICUT

The hull is of wood, built by Robert Palmer and Son, Noank, Conn., and the machinery was constructed by Wm. Cramp and Sons' Ship and Engine Building Company. The diameter of the high pressure cylinder is 56 inches, low pressure cylinder 104 inches, and the stroke is 132 inches. Steam is supplied by six gun boat boilers, at a pressure of 120 pounds per square inch.

In repairing the engines several important changes and improvements have been made, and the illustration on this page is of the engines as they are today. The two piston rods of the low pressure cylinder, which were in a plane perpendicular to those of the

high pressure rods, have been replaced by a single rod 16 1-2 inches in diameter, and the friction of the rod in the stuffing box is taken up by segmental staves of steel, Babbitt lined. The box is made steam tight by packing rings at the upper end. Water circulation is provided through the guide holders in the cylinder head.

Another defect in the engine was the side thrust of the cylinders, owing to the difference of steam pressure in the trunnions on the two sides of each cylinder. In rebuilding the engine this side thrust was taken up by introducing a ball bearing consisting of one hundred 2-inch hardened steel balls, running in hardened steel ball tracks. The trunnions are supported in adjustable quarter boxes of chilled cast iron, and provided with water circulation through annular holes extending lengthwise through the trunnion between the steam passage and bearing surface. Oil lubrication is secured on the bottom of the moving trunnions by holes in the quarter boxes and grooves in the moving bearing.

The valves on this engine are of the Wheelock grid-iron type, and permit of delicate adjustment. The small size of excentric rods, as seen in the engraving, shows how easily these valves are operated and what little power they require. The valves are located on the top of the cylinders, a steam and exhaust valve at either end. There is an independent cut-off gear for tripping the steam valves.

This style of engine is seldom seen in these waters, the only other vessel equipped with oscillating cylinders of this type being the freight steamer *Nashua*. In England and on the Continent oscillating engines were used extensively on channel and coast steamers, but in these cases the cylinders were generally mounted vertically below the shaft and worked on two cranks. The principal advantage of this type of engine is directness of application of the power by dispensing with the connecting rod, but it is questionable whether this advantage is not more than overweighed by the absorption of power required to oscillate these immense cylinders. The cut on the preceding page is reproduced from *Power*.

Repairing the Torpedo-boat Destroyer Salmon.

The British torpedo-boat destroyer *Salmon*, which was built by the Earl Company in 1895, and is one of the original fleet of 27-knot boats, was run into during the last winter by the channel steamer *Cambridge* during a heavy fog on the North Sea. The *Cambridge* struck the destroyer on the port side, almost amidships, and in order to save the crew the bow was kept in the indent made in the side of the destroyer. This indent was 5 feet deep and 8 feet broad in a fore and aft line, and was triangular in form, the apex being toward the bow of the destroyer. The plates of the destroyer were torn and twisted and the bow was displaced in a most remarkable manner. The main rent, which is shown in the illustration, extended down to the bilge, the shell plating being driven through the timbers into the boiler room. The bottom plating was buckled up athwartships, as well as in a longitudinal line, and the deck plating was twisted and bent. The starboard shell-plating was also buckled, the bow was driven out of line to the extent of 15 feet, listed to starboard to the extent of 5 inches in 12 feet, while the keel was from 6 inches amidships and 21 inches at the stem lower than the stern, which remained unaffected. Such a contortion in all three possible directions is unique.

The section of the *Salmon* is much the same as those of the destroyers building in this country. The shell-plates are 7 pounds per square foot and the sheer-strake stringer 9 1-2 pounds. The frames are 2 1-2 by 1 1-2 inches by 2 1-2 pounds angle bars, spaced 20 inches centers. Fore and after coal bunker bulkheads are on either side about 3 feet from the sides. These bulkheads are of 4 and 6 pound plating, stiffened by 1 1-2 by 1 1-2 inch by 1 1-2 pound angles. The beams are 2 1-2 by 1 1-2 inch by 2 1-2 pounds. The sheer-strake angle 2 by 2 inch by 3 1-2 pounds, and the double continuous longitudinal angles in the coal bunkers are 1 1-2 by 1 1-2 inch by 1 1-2 pounds.

THE WRECKED TORPEDO BOAT DESTROYER SALMON.

The vessel was brought into Harwich harbor and there beached and temporary repairs made to enable her to be towed to Ipswich, where, although there is no dock, a soft mud beach was available. At Ipswich further repairs were made to enable the boat to be towed to Sheerness dock yard, where she was finally repaired. Wooden planks were fitted over the rent and a deck stringer plate 3 feet 6 inches broad and about 24 feet long was laid. A sheer-strake or girder over 30 feet long and 4 feet 6 inches deep, with double angle bars at top and single bar at bottom, was riveted to the plating forward and aft of the fracture, and was also secured to the wooden planking and deck stringer plate. Four girders were placed in the bottom of the ship and the bottom skin plating was reinforced by a special plate.

Thus strengthened, the destroyer was towed to the dock yard by a wire hawser, which was placed around

the boat with a shackle at the bow, so that no strains would be brought on the forward structure. The steering of the boat was very difficult, owing to the swerving of the bow.

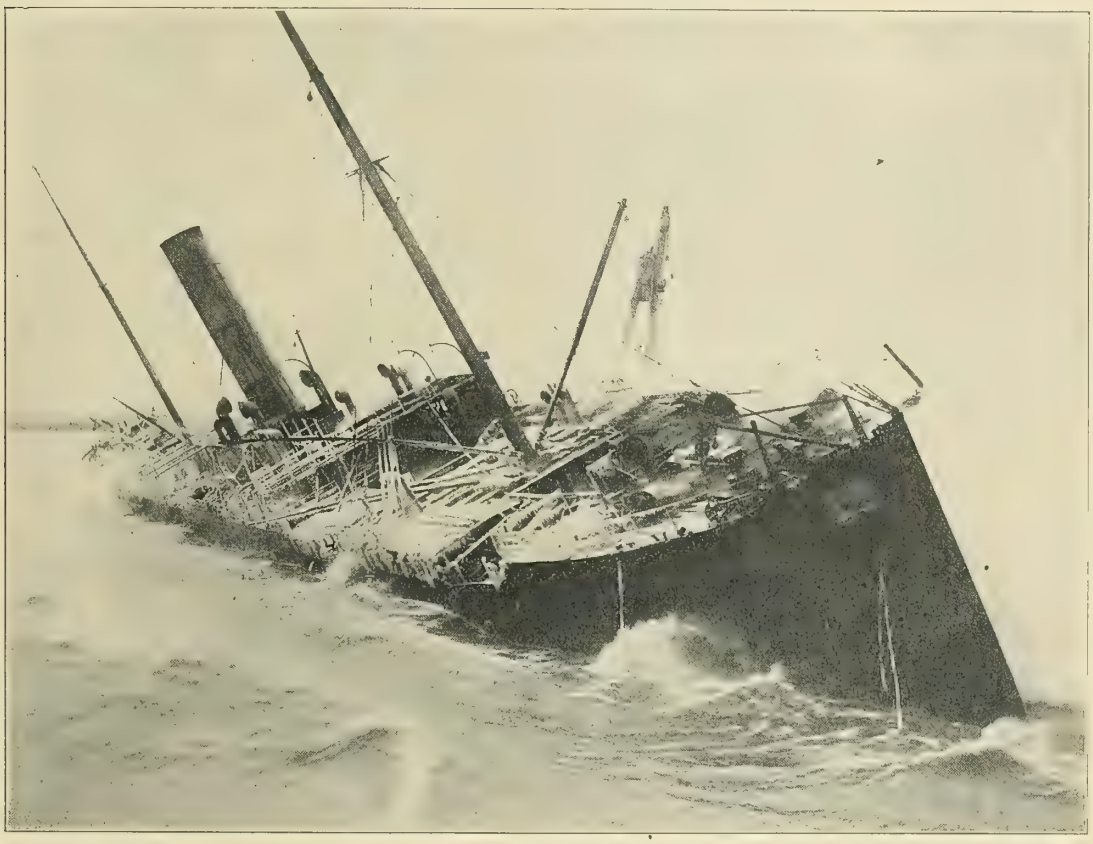
On arriving at Sheerness it was necessary to take the exact draft at many points along the keel, and the dock blocks were laid to suit this form. At the same time the usual keel blocks were set in the central line of the dock true to the ultimate line and level of the keel. Timbers were laid across the dock on which were built three cradles for carrying the bow. The ship was then cut completely in two and the fore body first brought into a true vertical line by shoring within the cradle, which was subsequently lifted above the level of the ordinary dock blocks by hydraulic jacks and then slipped over until the fore part of the hull was in line longitudinally with the after part. Due to the buckling of the plates, the over all length of the boat was 3 feet less than the original, and, therefore, the bow was drawn ahead this distance and finally lowered to the central dock blocks as originally prepared.

About 32 feet of the ship in the neighborhood of the rent was cut away and a new part built in. The boilers, which had received considerable damage, were repaired and the vessel given a general overhauling.

The above facts and accompanying illustration are taken from *Engineering*.

Burning of the Steamer British Queen.

A second Hoboken fire, more spectacular but not so disastrous as the one which occurred 21 months ago, broke out March 18th on the Phoenix Line pier, completely destroying that pier and seriously damaging the steamer *British Queen* and several lighters which were lying alongside. The fire broke out at night time on the river-end of the pier and fanned by a forty-mile gale of wind, quickly spread throughout the length of the shed and into the hold of the *British Queen* through her cargo ports. The crew and longshoremen aboard only saved their lives by jumping into the water and swimming to places of safety. Before the ship could be towed into the stream, fire had spread from stem to stern. Many tugs and fireboats came to the scene, but the most they could do was to prevent the flames from spreading to the adjoining property of the Holland-American Company.



STEAMER BRITISH QUEEN SUNK IN NEW YORK BAY.

The ship, enveloped in flames, was finally drawn into midstream and carried by the ebb-tide down the river to opposite Bay Ridge, where she grounded and sank. The burning barges, which were towed from the burning ship also started towards the Bay. Some of them striking the piers on the New York side, and, on Governor's Island, started small fires, which fortunately, however, were extinguished by the fireboats before serious damage resulted. The *British Queen* continued

to burn for many hours until her holds were flooded with water from the pumps of the wrecking boat moored near by. A large part of the cargo was made up of oil. The accompanying illustration shows the ship as she lay aground after the fire had been put out. She was built at Newcastle in 1890 and is 400 feet long, 47.2 feet beam and 28 feet deep. The pier was burned to the water's edge.

The origin of the fire is not known, but it was reported that it broke out among some boxes of cartridges stored on the pier which were to be shipped on the steamer to South America via Belgium.

Oil Fuel.—The first ship to cross the Atlantic with boilers burning oil fuel was the British tank steamer *Clam* owned by the Shell Trading and Transporting Co. which arrived in Philadelphia recently. Many vessels of this company are equipped for burning oil fuel. One of the advantages this system has over coal, which is not generally appreciated, is in the amount of fuel that can be supplied to the boilers. The human element comes so largely into play in the stokehold that the maximum speed of an ocean liner is frequently not attained because of the inability of the firemen to shovel enough coal through the furnace doors. Another advantage of this fuel is that the amount of oil can be absolutely regulated by the engineer. While this class of fuel is limited to a certain extent to ships plying between oil producing countries, yet the discovery of oil in Texas has greatly increased the world's supply and will reduce the cost of this fuel.

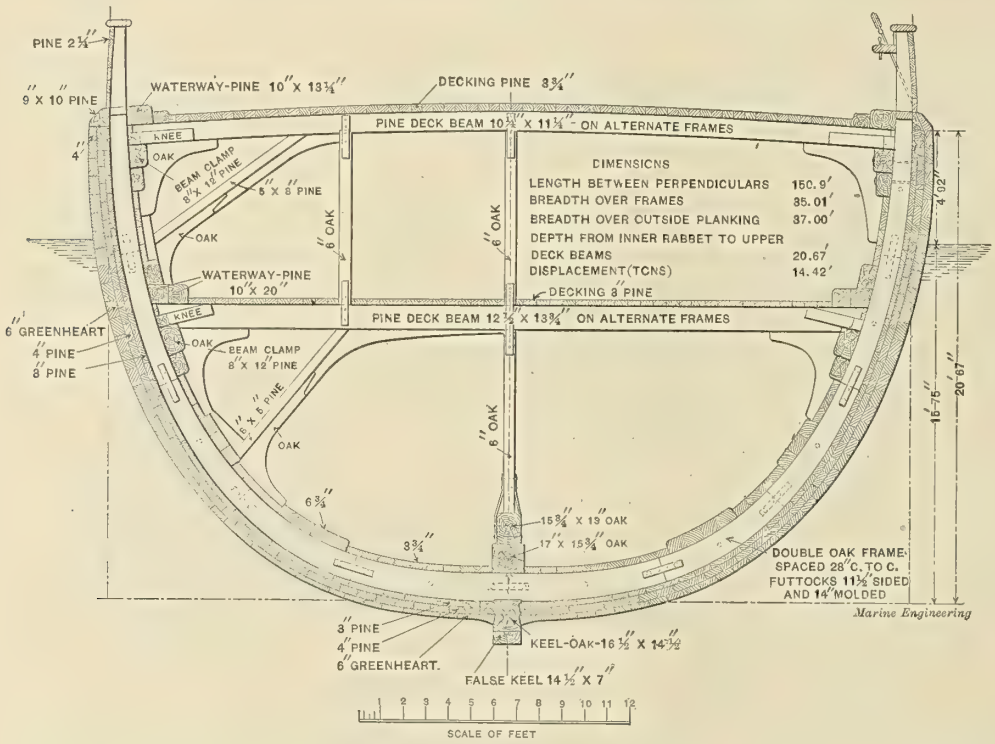
THE STEAM BARKENTINE GAUSS OF THE GERMAN ANTARCTIC EXPEDITION.

Designed and Built at the Howaldtswerke, Kiel, Germany.

BY GEORGE CROUSE COOK.

The present German Antarctic expedition is, as is well known, promoted by the German government and was officially authorized by an imperial decree addressed to the Chancellor of the State. This decree formally directed the object and duties of the expedition and appointed Dr. Erich von Drygalski, of the University of Berlin, to be the leader in the scientific work. The expedition, which left Germany early in August, 1901, will proceed first to the island of Kerguelen, where a magnetic and meteorological station will be established. It will then push south for the main object of exploring the Indo-Atlantic side of the South Polar Region and where a second scientific station will be established if suitable land is discovered. This station will be kept open for observation and study for at least one year, while the main body of the explorers will survey and map as much of the region as they are able to cover. The party will attempt to return with their ship either in the spring of 1903 or 1904, as the leader decides to be the more profitable.

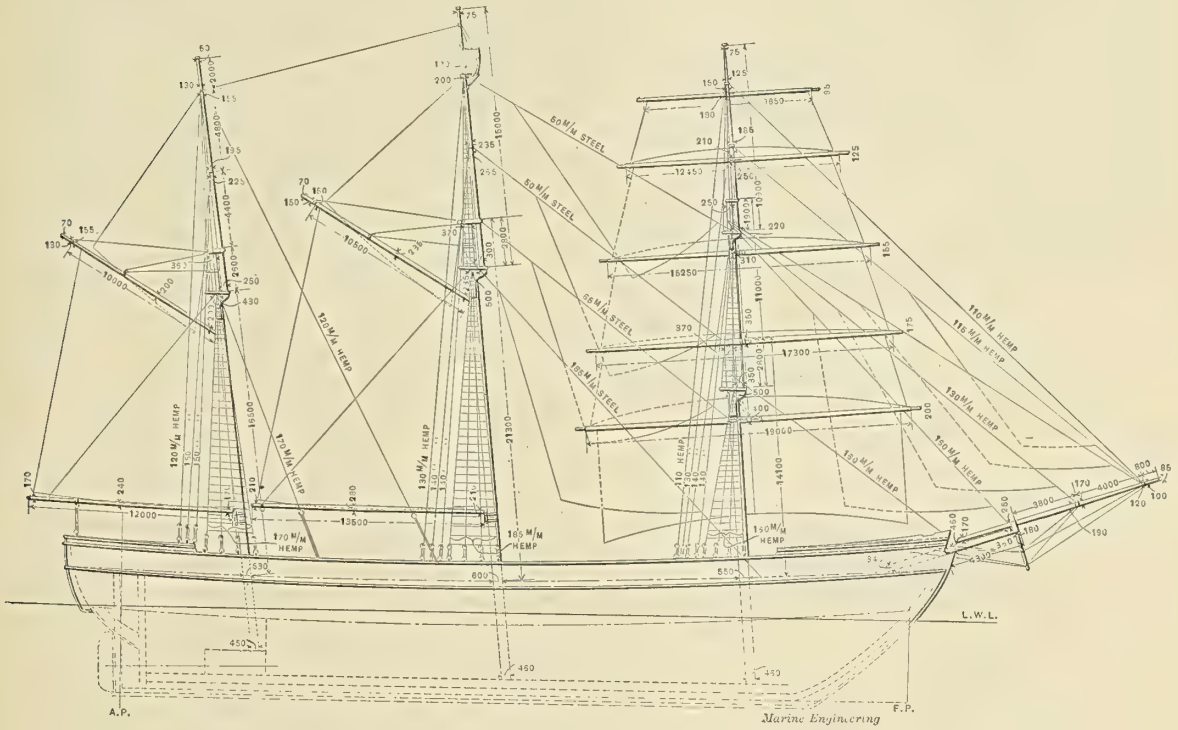
The brightest hopes are held for the complete success of the expedition, and no expense or care has been spared in supplying the best equipment and outfit that could be acquired. The ship was designed and built particularly for this expedition and the party may be said to have in the *Gauss* the finest vessel that has ever started on a similar service.

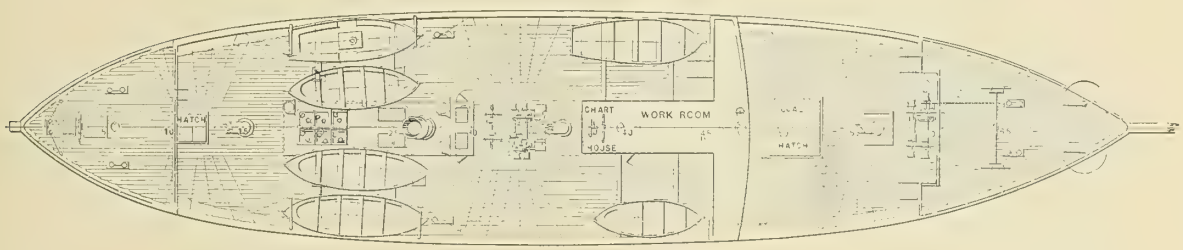


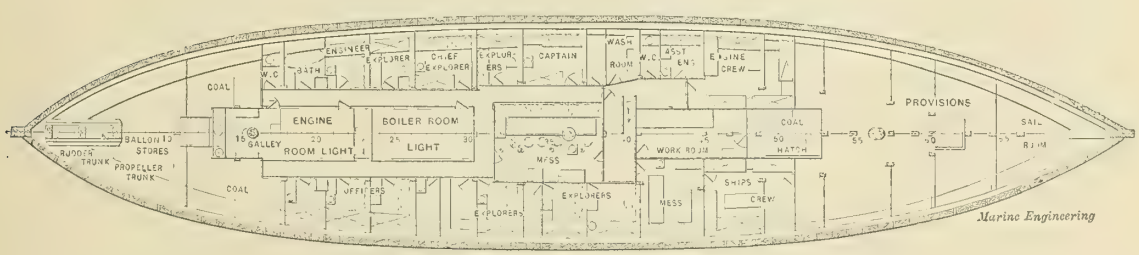
MIDSHIP SECTION OF BARKENTINE GAUSS

The leading features and dimensions of the vessel may be noted as follows: Length between perpendiculars, 150.9 feet; breadth over frames, 35.01 feet; breadth over the outside planking, 37 feet; depth from inner

The detailed characteristics of the construction and arrangement of this splendid vessel may be pointed out for their full appreciation, and each of the following points may be noted in the accompanying plans, which







SAIL PLAN AND DECK PLANS OF THE BARKENTINE GAUSS.

rabbet to upper deck beams, 20.67 feet; indicated horse power, 275; speed with 728 tons deadweight on board, 7 knots; total displacement in salt water, 1,442 tons. It will be understood that the odd decimals appearing in the figures are developed in the change from the metric system of measurement used in Germany.

are reproduced from the builder's drawings. In each feature of the design and construction the ruling idea was to advance the efficiency of the vessel for the object which it was to serve and a study of the following plans will show to what a high point this has been achieved.

As the form of the vessel was the first item to receive consideration in the design it will be well to give that the first notice. In the outline of the midship section the key to the whole design of the form may be seen, and it was so chosen to cause a vertical resultant in the compression of ice about the vessel which would tend to lift it bodily rather than crush in the sides. The same idea may be noted in the profile of the stem and stern which fall in below the water line, and, as far as possible, all projections which could possibly give a hold to the ice are cut away. In the general arrangement plan it may be seen that both the rudder and propeller may be drawn vertically up into trunks designed for the object, and thus preserved when surrounded and racked by ice. The removal of the rudder and propeller also serves to reduce the possible grip of the ice on the ship, which would prevent it from lifting. The rig used is that of the barkentine, or three-mast schooner as it is called in Germany, and one which stands commended for simplicity and efficiency in itself. The sail area is comparatively small, but necessarily so, for the severe conditions in which the vessel will serve. The masts and yards are strong and heavy, and steam winches are placed on the upper deck at convenient points for working the sheets and braces. Practically all the standing and running rigging is made up from hemp rope, as this can be handled with greater safety in intense cold than that made from steel wire.

The arrangement of the vessel has special reference to warmth and convenience. The accommodations for the officers and men are all placed in the 'tween decks, as may be seen on the plans. Separate cabins are prepared for scientists of the expedition and officers of the ship, but they have common mess and work rooms. The absence of side lights or ports will be noticed, and this leads to the feature of the arrangement which places the principal rooms, that is the mess and work room, in the center of the vessel, where they can be most conveniently lighted from overhead. The ends of the ship, both on the berth deck and in the hold, are filled with ship's stores and provisions, except aft on the berth deck, where a compartment is given up to the balloon and aeronauts' equipment, with which the expedition is supplied. In the hold a section of the space is taken up by the engine and boiler compartment, but the greater part is given over to the coal bunker, or rather the coal hold, which has a capacity of 340 tons. Additional coal is carried abreast the boiler room and on the berth deck, which gives a total supply of about 400 tons. A low poop and topgallant forecastle are built in on the line of the bulwark and give accommodation for the dogs and dog supplies carried by the expedition. On the upper deck amidships are two deck houses, the after one being merely the engine and boiler room casing carried up to form a short boat deck, and the forward being a chart house, work room and base for the navigating bridge. An additional steering wheel is fitted on the poop aft, and used principally when the vessel is under sail.

The construction of the craft is as strong and efficient as it could possibly be made. Oak and yellow pine are used throughout and probably in as large quantities as has ever been the case in a craft of equal size. This fact will be evident by a note of the midship section.

The outside skin of the vessel is particularly noteworthy, as it is made of three completely independent layers of planking. The two inner layers amidships are made up of yellow pine 3 inches and 4 inches thick respectively, but changed to oak of equal thickness at the ends. The outer layer is of selected Demerara greenheart, varying in thickness from 3 inches on the bottom to 6 inches at the water line, and is carried all fore and aft. A heavy coat of marine glue is laid between each layer of this planking and all the seams carefully calked.

Practically the only metal used in the construction of the vessel, outside of the connections and fastenings, is in the engine and boiler room bulkheads and casings, which are made up of steel plate and stiffened by steel angles in the usual manner.

While the main dependence of the vessel for propulsion is on the sails, the engine and boilers are capable of developing a speed of 7 knots per hour when steaming at full power. The engine is of the direct-acting, triple-expansion type, developing 275 I. H. P. when turning 130 revolutions per minute. The diameters of the cylinders are 12, 19 and 30 inches, and the stroke is 18 inches. Steam is supplied by two cylindrical fire tube boilers, each 7 feet in diameter and 9 feet 3 inches long. Each boiler is fitted with Morrison suspension furnace and carries a pressure of about 180 pounds.

All the living rooms of the vessel are steam heated by radiators of such size as to keep the temperature at + 10 degrees Centigrade when there is a temperature of — 30 degrees Centigrade outside. The vessel is also lighted throughout by electricity, and in these items the expedition is by far the best equipped that has ever sailed.

The equipment of the vessel is equally complete and satisfactory for the service. The usual equipment of anchors for a much larger craft is supplied, and, in addition, special ice anchors and much spare chain and hawsers. All the main sails, rigging, blocks, etc., are in duplicate, and a heavy awning is supplied to cover the entire upper deck. A complement of five boats and a naphtha launch are carried; each of these is completely equipped with masts, sails, water tanks, compass, etc.

The complement of men starting with the *Gauss* on this bold expedition, and with whom the success or failure so much lies, consists of eight explorers or leaders, four officers of the ship, three engineering officers, twenty men in the ship and engine crew, and a cook and steward. Each of these men was carefully chosen for his particular fitness in this work and, for some time before the expedition left Germany, was given special training in his duties.

Liquid Fuel.—Interesting trials in fuel oil burning have recently taken place on board the North German Lloyd Company's ship *Tanglin*. This steamer was lately chartered to convey Eskimo dogs and equipment to the German South Polar exhibition from Bremen to Kerguelen Island. On the homeward voyage the ship took 350 tons of Borneo oil at Singapore and from there to Bangkok burned 13 tons of oil a day. It is stated that if coal had been used 18 tons of British or 20 tons of Japanese coal would have been required to drive the ship at the same speed.

Oil Fuel.

We have frequently heard of late years the cry of warning because of the rapid consumption of available coal. Whereas the eventual destruction of the coal fields is a remote possibility, yet at present we now have opened up to us, through the discovery of the oil fields of Borneo and Texas, a supply of cheap liquid fuel that seems almost inexhaustible. For many years the great fields of the Alleghanies and Russia have supplied the world's demands for mineral oil for lubricating and illuminating purposes and for the various arts, but the supply has not been large enough to warrant oil being used generally as a fuel. In these two great fields of Borneo and Texas, located almost diametrically opposite on the earth's surface, with the auxiliary fields of Pennsylvania, California and Europe, we find sources of supply well located for the general distribution of oil. At present fleets of steamers are engaged in transporting the oil to the cities of the world, and the shipyards in this country are being filled up with orders for oil barges and steamers to further augment this fleet.

Oil is an ideal fuel for use on board ship, and the many experiments which are being carried on at present assure us that the difficulties of burning oil under a marine boiler will soon disappear. These experiments are being conducted by several companies independently of each other, and the reports received at present indicate that the success attained is so great that the companies are to equip more steamers with oil burners. It is stated that not less than fifty steamships have been fitted out with oil burners by a single English company. Two of the transatlantic lines, and many others traversing the Atlantic and Pacific, are also equipping their ships for this fuel.

The prejudices against oil as a fuel are thus disappearing in view of its many advantages. The relative heating value of oil and coal are about as 1.7 to 1 per unit of weight, and the space required for stowing a ton of oil is about 35 cubic feet in comparison to about 45 cubic feet for coal. The oil can be stored in the water bottom or ballast tanks of ships, thus occupying unavailable space, and throwing open for cargo space formerly occupied by the coal bunkers. The question of securing complete combustion has already been solved, so that no smoke nor soot are formed. On account of the lighter weight of oil per unit of heat the carrying capacity of a ship is also increased. The largest economy is found in the saving of labor, for with oil, not only are there no ashes to remove, but one competent fireman can perform the work of four or five men when coal is burned. In loading the oil, much less time is required than in loading coal, for the liquid can be taken on board in port through a hose from tank barges at the wharf, similarly to receiving fresh water supply.

It is difficult to compare the cost of the two kinds of fuel, owing to the several elements of labor in the stoke-hold and in loading, space saved, which would otherwise be devoted to cargo space, and first cost of the material. As to the latter item, with coal containing about 14,000 B. T. U., at $4 a ton, the cost of oil for the same amount of heat raising power would be about 90 cents per barrel of 42 gallons.

It is generally conceded that it is necessary to heat the oil before piping it to the burners. In former installations these heating coils were placed in the uptake, where they were subjected to a high temperature as a result of which carbon was deposited on the inside of the coil, and, in one or two instances, the coil eventually burned out and the oil flowed down into the boiler causing disastrous fires. Now, a temperature of 140 to 180 degrees for the oil seems to give the best results, and this heating is secured by coils placed in settling tanks through which exhaust steam is passed. To remove the water from the oil, two settling tanks are provided. The size of these tanks depends on the amount of water found in the oil; the percentage of water in Texas oil is very small and the tanks are therefore of a size sufficient to contain but three or four hours' supply. If the water is not removed and enters the burner it puts the flame out, and, when the oil enters again, it runs into the furnaces unconsumed and is liable to cause severe explosion.

Most of the appliances heretofore used have been adapted to the present type of Scotch boiler, and some of the burners have been so arranged that the furnace can be used for burning coal also. This does not appear to be good engineering, and we may look forward to the day when a new boiler will be brought out to meet the special requirements of oil fuel.

It appears to be the general belief that a large combustion space must be provided and that the gases should have direct contact with the plates of the boiler rather than having a brick lining intervene. There are many patented burners on the market, all with good points about them, but the greatest success seems to be found with the burners which use oil, and air or steam at a low pressure. The function of the burner is simply to divide the oil into a fine spray and mix it with the proper quantity of air for complete combustion. Satisfactory results have been attained with oil under about 20 pounds pressure and the air under 8 to 16 ounces pressure. The disadvantage of using steam for spraying the oil on board ship lies in the fact that larger evaporators must be supplied to make up the quantity of water used for the purpose of spraying, which varies from 2 to 10 per cent. of the total evaporation. The total power required for the air and steam blast will be found from about 5 to 15 per cent. of the power developed. The most successful experiments appear to have been made with hot air forced or induced-draft systems, such as the Howden, and Ellis and Eaves, where the entering air is first heated by the escaping gases.

Certain it seems that, with the large supplies of fuel oil and the many advantages of this kind of fuel, we shall soon find many of our steamers burning oil under the boilers.

Trial Trip of Shawmut.—On March 22d the steamship *Shawmut*, belonging to the Boston Steamship Company and built by the Maryland Steel Company, was given a light draft trial. A speed of 14.78 knots was maintained, draft forward being 12 feet and that aft 18 feet, displacement 8,440 tons. The twin-screw engines making 95 revolutions per minute, developed about 5,000 horse power. A complete description of this ship was given in Marine Engineering of January, 1902.

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Notice to Advertisers.

Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.

THE request which the contractors building torpedo vessels for the Government have recently made regarding an increase of 40 per cent. in the contract price, is one which the Navy Department will perhaps hardly find authority for granting, without special legislation from Congress, but we believe that the attitude of the Department will be generous regarding the matter, and if brought to the attention of Congress, as it probably will, we trust that it may receive favorable consideration and that such additions to the price for these boats will be made as may seem fair to both parties to the contract, having in view all the circumstances of the case.

It is an unusual request, but the situation is unusual and we believe justifies the departure from the usual policy in such matters. In 1898, when Congress appropriated the money for these sixteen destroyers and twelve torpedo boats, it was specifically provided that not more than five destroyers or four torpedo boats should be built by any one contractor. The obvious purpose of Congress was to distribute the work among the different shipyards and to stimulate and foster the investment of money and skill in the equipment of such engineering plants as should be able to do work of this high character. It must at the same time be admitted that the number of establishments capable of doing such work at that time was very small, and we should also remember the highly specialized character of the work on vessels of this description, and the admitted fact that of all classes of marine design and construction it is one where the attainment of the highest results necessarily calls for previous experience with work of this character, together with the highest technical and constructive skill in utilizing the results of such experience and in carrying out the work itself. Having in view these facts it was manifestly too much to expect that establishments without experience, with neither a technical nor operative staff trained in work of this character, should be able off-hand to achieve the advanced results aimed at and fulfill the difficult specifications supplied by the Government, especially within the limits of cost fixed.

The report of a special Board of Naval Officers appointed to investigate the condition of these boats has been made public, and we presume is familiar to our readers. The chief points may be summarized as follows:

With scarce an exception the boats will be overweight to a varying extent, but in many cases as much as 40 tons or upward. Few will be able to attain the speed anticipated. In some cases the structure of the boat is manifestly weak. In many cases excessive vibrations appear at high speeds, due to poor balance in the engines and to weakness of hull. In a general way, the destroyers will be more satisfactory and serviceable than the torpedo boats. Of the latter, while some are likely to prove good boats of their class, others seem likely to prove flat failures. Having in view the points referred to above, is this general result really surprising? Looking at the situation with the benefit of experience, is it not what we might have expected, having in view all the circumstances of the case? In fact it is probably not too much to say that there have not been lacking some who have foreseen this result from the first. Whatever may have been the causes that have led to the present situation regarding these boats, however, we believe that we should now look at the present and to the future rather than the past. A condition exists. Whether Congress or the Navy Department or the individual contractor is the more responsible for the condition, is a question

which we do not believe should be pressed, especially in view of the admitted fact that all have undoubtedly been honestly working for the accomplishment of the purpose intended.

The facts of present importance are these:

The construction of the present boats has been a school of training for the contractors, and the experience and benefit which they have derived are, of course, undoubted. In consequence there now exists in the United States, for the design and construction of boats of this character, a store of potential ability and capacity immeasurably beyond that available in 1898. This fact is indisputable. Now, in the broad sense, which profits the more by reason of the existence of such potential capacity? Undoubtedly the Government as representing the interests of the nation at large. Since, therefore, the Government profits the more, and since such experience and such potential capacity could have been gained in perhaps no other way, it seems only fair that the Government should pay. We believe, furthermore, that it is worth all it will cost. The capacity to improve on the past, the capacity to build boats of this type which shall be improvements on those now approaching completion, could have been acquired by no other mode of procedure than that which has been followed; and while the results may not be altogether satisfactory as regards the present output, the capacity for improvement in the present and immediate future is the result of chief importance. And since this is far more to the advantage of the Government that the private contractor, we believe that a wise and just policy on the part of the Government will dictate a generous treatment of the contractors, and we trust that a measure of relief may be passed which will fairly reimburse them for the part which they have thus taken in upbuilding the capacity of our country for the production of ships and munitions of war.

THE question of oil fuel on shipboard seems to be attracting increasing attention at the present time. The entry into the market of the Texas and Borneo supplies in relatively recent times puts a somewhat different aspect on the question of the use of oil for fuel purposes. Regarding the possibilities of such use from the engineering point of view, there has been no doubt from the very first. Such difficulties as have arisen have had reference solely to matters of detail, and in no important fundamental point has the use of oil presented any serious difficulty. The question has been very largely a commercial one. With most of the supply in sight spoken for in other branches of industry and for other purposes where more could be obtained for it than by its use as fuel, it was very uncertain where the price of oil would go if there should suddenly arise large demands for fuel purposes. With new supplies available, however, and with a reasonable probability of a price for oil which will enable it to compete with or even outclass coal, it is not surprising that renewed attention should be given to the engineering details relating to its successful use.

In the various systems and methods for burning oil in use or proposed, the following seem to be the essential items: (1) Settling tanks which will allow the small amount of water to separate and sink to the bottom where it may be drawn off as occasion requires. (2) Suitable burners for bringing about the proper conditions for the perfect combustion of the oil. (3) Suitable protection for the furnace sheets against the direct action of the impinging flame.

The greatest variety exists in the nature of the burners and in the methods employed for the perfection of the combustion. In a general way, however, these methods fall under two groups: Those which introduce the liquid as a spray atomized by steam or compressed air or both, and those which seek to first vaporize the oil and introduce it as a vapor. In both cases it is to be presumed that the substance burns as a vapor. The real difference in the two systems would seem to consist in this, that in one a liquid spray is introduced which almost instantly flashes into vapor and then ignites, while in the other the change into vapor takes place outside the furnace, whence it is then introduced, mixed with air, and ignited. Higher efficiency of combustion has been claimed for the latter system. This, however, is very largely a question of air supply in proper amount and thoroughly mixed with the spray or vapor. Heating the air is found to be an important feature in modern systems. This follows the analogy of hot draft in general, and a hot blast is also much more efficient as a vaporizer than a cold blast. To close with a word of advice, the progressive marine engineer will do well to keep his eye on the modern developments relating to the use of oil as a fuel.

MISHAPS AND REPAIRS.

Engine Breakdown.

A few years ago I saw a breakdown on a small steamer, an account of the makeshift repairs to which may probably prove interesting to your readers. The *T*—— was a small steamer with a two-cylinder compound engine, the cylinders being 15 and 30 inches in diameter and 24 inches stroke. A new boiler had just been put in and the pressure increased from 70 to 85 pounds, and the vessel was making her second voyage. Everything had gone very comfortably until we were about 350 miles from our destination. The second engineer had just relieved the chief at midnight and was just taking his customary look around when a terrible jar and a jerk somewhere aft gave notice that something had gone wrong.

It was the work of a moment for him to jump to the throttle and shut off steam, but too late, for with a shower of sparks the low pressure crankpin broke close to the forward web of the crank. The captain was immediately notified and the boiler made safe. The chief, who had returned to the engine room, now took a hand lamp and proceeded to investigate the cause and extent of the damage. It was found that three of the four bolts in the after coupling had sheared off and the forward part of the shaft had turned around the remaining bolt, bending the shaft and breaking the keeper bolts of both the spring bearing and the after main journals, in addition to bending the low pressure eccentric rods and breaking the after crankpin. After realizing the full extent of the wreck it became a question of how we were to reach port. We had a valuable cargo of a perishable nature, and of course every hour's delay was calculated to make things worse.

The engine, as I have already said, was an ordinary two-cylinder compound with balanced cranks. The air pump was driven from the L. P. crosshead; the circulating pump was an independent centrifugal pump and the feed and bilge pumps were driven from a disc on the forward end of the shaft. The valve gear was the ordinary link motion with the slide valves on the forward and after ends of the engine, the cylinders being side by side. The first suggestion was to drill a hole through the broken crankpin and put a bolt through and rivet it over. But this proposal was summarily settled by the remark that there was neither ratchet nor drill on board. In fact a few chisels, a couple of files and a really good set of taps and ties were the only tools on board. It was then decided to try and fix things up and run home with the L. P. engine. Three bolts were made out of a big slice bar for the after coupling. Threads were cut on both ends and the old nuts used and three nuts we stole off the foundation bolts. The bolts out of the forward and center journals were taken to replace those broken in the after journal and spring bearing.

The H. P. engine was stripped, the rods being lashed to the columns out of the way. The forward part of the shaft was lifted and the brasses taken from under to allow it to slide forward out of the way. It was then forced forward and secured with wooden wedges. The H. P. piston was secured at the bottom of the cylinder and the H. P. valve taken out and the bottom port stopped with some sheet gum and wedges, after which the steam chest cover was replaced. The L. P. eccentric rods were taken down, heated in the furnace and straightened and then put up again. All being now fixed but the broken crankpin, that was taken in hand. It was broken with a pretty clean straight break about a quarter of an inch from the forward web of the crank. We stripped the brasses off and rounded the edges of the break nicely with a file and then put it together again and were ready to turn over with the turning gear. Upon turning over we found the bent shaft was going to give further trouble, but we got over that by putting two strong shores from the top of the after journal under the bottom of the cylinder and lashing them secure, and then slacking up on the foundation bolts so that the whole thing could accommodate itself to the slight vagaries of the shaft.

We were now ready with the exception of the feed pump, and that we decided we could dispense with, letting the air pump discharge into the bilge and pumping from the bilge to the boiler with the donkey pump. So we got steam to 30 pounds and prepared to make a start. The chief took the throttle and had her pretty well warmed up. We then turned her just over the top center and removed the turning bar and gave the word "All clear." He gave her the steam with a jerk, but she only went to the bottom and there stuck. This process was repeated perhaps a dozen times with the same result, until at last the chief got disgusted and gave it up, telling the second to try what he could do. The second had been around "one legged jobs" before. He had her turned just off the bottom and began to lift her nearly to the top with a little steam and then pushing her down again until she began to form a little vacuum. Then he gave her the steam and over she went, and we were away after twenty-six hours of incessant work. The old engine walked all over the engine room every revolution, but she kept going. We reached home without further mishap, only stopping occasionally to let up on the coupling bolts. We made about 4 knots per hour and docked the vessel without any assistance. And now comes the aftermath.

The insurance companies made the captain a very substantial present for bringing his ship home without assistance, and the owner "fired" the chief and second engineers for letting her break down. But then, they were only a pair of "shovels," so what could you expect?

D. E. F.

Auxiliary Machinery Mishaps.

One very rarely hears or reads of breakdowns that do not directly concern either the main engines, the gear connected thereto, or the boilers supplying them with their power. Are we, accordingly, to infer that mishaps to the hundred-and-one auxiliaries are so insignificant that they are not worth recording, or that they never occur at all? I do not think that any sea-going engineer who has been so fortunate—or perhaps so unfortunate—as to put in some of his time on a modern transatlantic greyhound would answer this question otherwise than by an emphatic negative. The present system of fitting up the engine room with as many in-

dependent units as possible minimizes the chances of a general breakdown, but it multiplies chances for individual troubles, and it is rare that any single pump or engine can go out of business without making its effect felt throughout the whole system, thus influencing to a greater or less extent, the "pulse" of the entire department, the "turns."

gine, but it was quite as apt to be a main-feed pump, or a circulating centrifugal, or even one of the air pumps, between which and the circulators there was naturally a strong bond of the "sympathetic strike" nature.

This vessel was fitted with Howden's system of forced draught. The fans were direct-connected to the

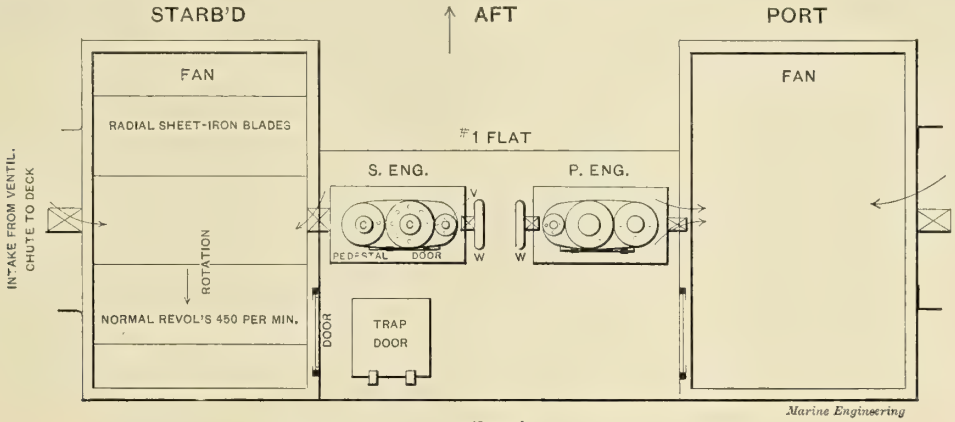


Fig. 1

The writer spent some months on a liner whose daily runs averaged not far from the 500-mile stretch. She was twin-screw, and her engines developed over 20,000 I. H. P. at about 90 revolutions. There was absolutely no attached gear of any description, and I only knew of

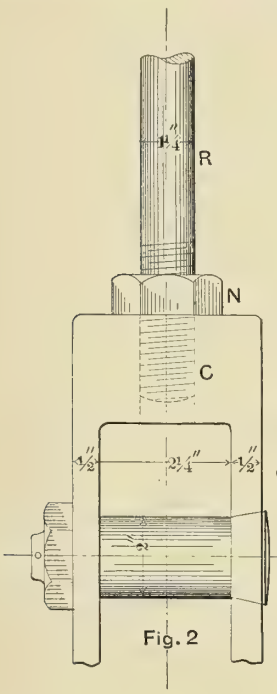


Fig. 2

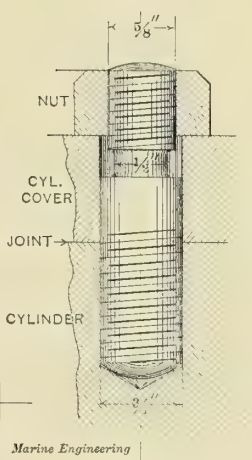


Fig. 3

her main engines stopping at sea for accident but once in over a year, and then only to tighten up a nut on the after-end of a link quadrant, and the job took not more than a minute. But there was never a trip, and seldom a watch, when the "turns" were not cut down more or less by trouble with one or frequently with several of the numerous auxiliaries. Very often it was a fan engines, and were supposed to be run not over 450 revolutions to the minute. The engines were heavy, upright, 2-cylinder machines, cranks 180° apart, with water-tight casings around the cranks and rods, running in a bath of engine oil and fresh water. In a cool and open place where they could have been readily and carefully inspected, I believe they would have given very little trouble; but situated as they were, they did not get quite the same solicitous care that was lavished

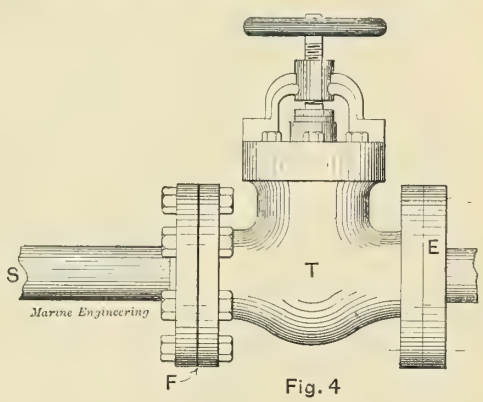


Fig. 4

on the gear in the engine room, and they took their revenge. They were located in small box-like rooms directly over the ends of the boilers amidships (see Fig. 1). The temperature in some of these rooms, or "flats," as we called them, was around 160 degrees F. with both fans running. With one stopped it ran up 20 degrees or so higher, and with both out of commission the place was unbearable and the carbonized grease around the engines frequently ignited and drove away the most fireproof of the staff till the stuff had burned away.

One of the favorite breaks was as follows: The piston rod *R* (Fig. 2) screwed into the cross-head *C* far enough to get the clearance right, and was then locked in place

with the nut *N*. This nut was always hammered up hard, but the vibration of the engine frequently caused it to slack back. The rod would then screw itself out by degrees, and soon the piston would be banging away at the cylinder-head. If anybody happened along about this time, the thing would be caught in time; if not it was only a question of minutes till the six studs gave way, and generally a few pieces of cylinder flange and walls as well. Then there was a nice, warm job on. The stock method of making this repair was to replace the head on a piece of thick asbestos joint, having put the broken pieces of cylinder back with plenty of red-lead putty. Then a block of wood was placed on the head, with a screw-jack top of that, bearing against the steel beam passing overhead, and shored down hard.

But this pro-tem method did not obviate the necessity of getting a new cylinder the next time in port, and as both cylinders and their common valve-chest were cast in one piece the smash was rather expensive. To this was due an improvement which shortly made its appearance, and while it did not lessen the chance of breakdown, made the repair much quicker and almost entirely did away with the chance of injury to the cylinder flanges. This was a stud, made as in Fig. 3. The necked-in portion was quite strong enough for the strain of normal running, but broke promptly under a blow from the piston, leaving a stump large enough to be easily gripped and removed with a Stillson wrench.

Of course we carried numerous spare cross-heads, brasses, pistons and rods, valves, and valve-spindles, eccentric straps, etc., and we needed them all. On one occasion, when a large portion of the casing was shattered by the connecting rod breaking way from its crank-pin bolts, a water-tight patch was fitted and bolted on, a piece of ribbed floor-plate being borrowed from back of the port engine for the purpose. I have seen other holes in the casings plugged and patched in most original and ingenious ways, utilizing everything from carpenters' wedges to spare zincs for the boilers, and more than once has a stout wooden plug, bolted or shored down, done yeoman service as a cylinder cover. The small flywheels shown at *W* in Fig. 1 disappeared in time and a cap was put on the end of the main bearing, preventing the leaking of the "slush" in the casing. And last, but not least, I have learned recently that so far as the fan engines are concerned this ship has become the proverbial "home," all due to a little wrinkle of the chief's.

It seems the principal cause of all the trouble was laid to excessive speed for the engines. They took their steam from the main boilers (200 pounds) through a reducing-valve at 120 pounds. When cleaning fires, steam generally fell to 185 or even lower. This meant a corresponding reduction of auxiliary steam and a consequent slowing of the fans at the very time they were most needed. Sometimes it was noticed that the steam on the fans did not fall in the same ratio as the main steam; and when the main steam went up again the auxiliary steam went up too, and also the speed of the fans. This meant lots of revolutions, so dear to the heart of the folks on watch—till a fan gave out somewhere out in the stokehold, and down came the steam again. As the reducing-valve was evidently the prime culprit, it was decided to trust it no longer, and the "Old Man's" scheme was put into execution. In Fig. 4, *T* is the throttle-valve to the engine, bolted on the valve-flange at *E*. *S* is the steam to the engine. At *F* was inserted a blank-flange of stout sheet metal, with a hole 1 inch in diameter in its center and thus considerably smaller than the pipe, though I have forgotten the exact size of the latter. This solved the whole trouble, simple though it seems, and so far as I can learn has not added any hours to the length of the voyage. The cry of "Port No. 1 gone up through the deck!" is now about as rare as "Man overboard!" while the boys off watch go quietly ahead with their pipes, their "7854," or their *Marine Engineering*, and stow their boiler suits and their brogans away in full confidence that they won't be wanted for eight long hours.

THEOR.

LAUNCHES.

Steamer Alice M. Jacobs.—The new fishing steamer *Alice M. Jacobs*, built for Capt. Sol. Jacobs, of Gloucester, Mass., was launched from the yard of Arthur D. Story, at Essex, on March 11th. This craft is built especially for fishing industry on the New England coast.

The principal dimensions are: Length over all, 141 feet 7 inches; beam over plank, 24 feet; depth, 12 feet; draft, 10 feet 4 inches.

Her keel, stem and stern post are of white oak; the frames are of white oak and hackmatack; the outboard plank and ceiling are of yellow pine, and the deck is of white pine. She will have a very large and roomy forecastle and galley, with ample accommodations for a crew of twenty-six men. From the after forecastle bulkhead to the machinery bulkhead is the main hold, about 50 feet long. It will be fitted up with bins, etc., for the stowage of ice, fish and stores in the most complete manner. Abaft the machinery space is the cabin with accommodations for the officers. She will be fitted to carry 40 tons of ice and the usual gear, boats, etc., of the most complete modern fisherman.

There will be about 35 tons of ballast, part of it being cement and iron punchings between the frames, and the remainder pig iron, stowed about the keelson.

The main engines are light and compact and of the vertical inverted compound type, with cylinders 18 inches and 28 inches in diameter, by 18-inch stroke and capable of developing 300 indicated horsepower. The cranks are set at an angle of 90 degrees. The main valves are of the piston type. There is a surface condenser with 600 square feet of cooling surface; air and circulating pump, feed pump and bilge pump, all independent, with inspirator and ejector. Steam will be supplied by two Almy water tube boilers, the breeching from which connects with a smokestack 25 feet high above the deck. It is fitted with a hinge so that it may be lowered to the deck when under sail. The working pressure is to be 150 pounds per square inch. The propeller is to be of cast iron with four blades. There is to be a steam windlass and a steam hoister. The owner also has under consideration the installation of an electric plant and a refrigerating plant. There are fresh water tanks with a capacity of about 3,500 gallons of water.

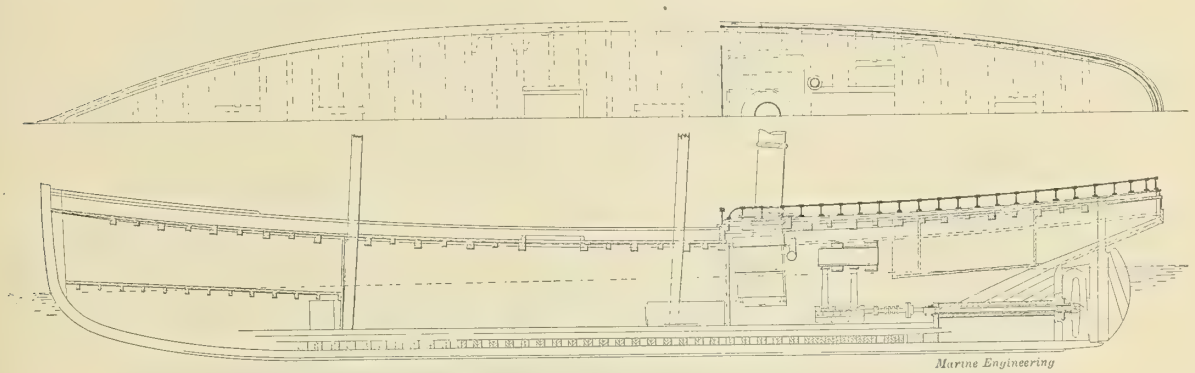
She was designed by Richard F. and William T. Keough, East Boston, the hull being built by A. D. Storey, Essex, and the machinery by Bertelsen and Peterson, East Boston.

Steamer G. J. Grammer.—The first winter launching to occur in Superior yards for several years took place on January 18th, when the steel steamer, *G. J. Grammer*, built to the order of the Seither Transit Company, of Cleveland, was launched. The vessel is 366 feet in length, 48 feet beam, 28 feet deep, and was built for the ore trade.

Steamship Columbia. — The steamship *Columbia*, for the Anchor line service between Glasgow and New York, was recently launched on the Clyde. The new steamer is 500 feet length over all, 56 feet molded breadth, 36 feet deep, with a gross tonnage of 4,800 tons and at load draft the displacement will be about 15,000 tons. The ship has handsome accommodations for the three classes of passengers. There are staterooms for 216 first-class passengers on the main and bridge decks luxuriously fitted up.

Steamer Etruria.—On February 8th the steamer *Etruria* was successfully launched from the West Bay City (Mich.) Shipyard. She is owned by the Hawgood Transit Company, of Cleveland, and is a single deck freighter. The dimensions are 434 feet length over all, 50 feet beam, 28 feet depth. Steam is supplied by two Scotch boilers 13 feet 2 inches in diameter, and 11 feet 6 inches long, and fitted with Ellis and Eaves induced draft. The engine is a triple expansion with cylinders 22, 35, 58 inches in diameter by 42 inches stroke.

Steamer W. H. Gratwick.—On February 1st there was launched from the Cleveland yards of the American Ship Building Company the steamer *W. H. Gratwick*, which is 436 feet long over all, 50 feet beam, 28 feet molded depth. Her carrying capacity is 6,200 gross tons of ore on 18 feet draft. The ship will have triple expansion engines, with cylinders 22, 35 and 58 inches in diameter by 40 inches stroke. Steam will be supplied by two Scotch boilers, 13 feet 2 inches in diameter and 11 feet 6 inches long, allowed to carry steam 170 pounds pressure.



FISHING SCHOONER ALICE M. JACOBS.

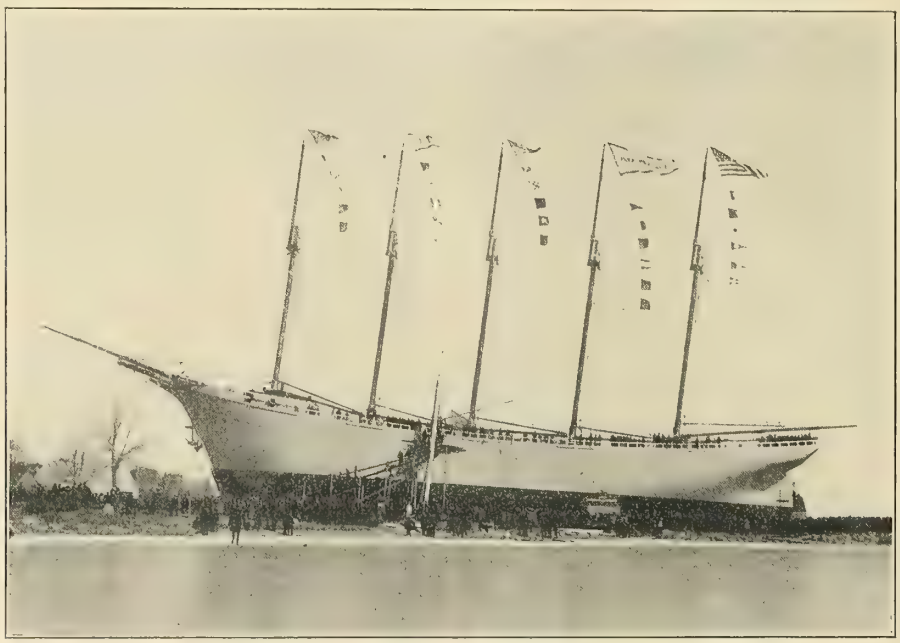
Steamship Hanoverian.—The steamship *Hanoverian* was recently launched from the Tyne for the Leyland line. She is built for the New York and Liverpool service and is of the following dimensions: Length over all, 601 feet; beam, 60 feet 3 inches; depth, molded, 42 1-2 feet; carrying capacity, 13,700 tons. The capacity of the water bottom is 1,650 tons and of the deep ballast tanks 3,500 tons. The vessel has accommodations for 245 cabin passengers in the bridge house amidships.

Steamer City of Memphis.—The steamship *City of Memphis*, for the Ocean Steamship Company, was recently launched from Roach's Shipyard, Chester, Pa. The ship is of the following dimensions: Length over all, 395 feet; beam, 49 feet; depth, 27 feet. The vessel is of steel throughout, with double bottom the entire length, and is of the hurricane three deck type. The ship is primarily for the carrying of freight, but there are accommodations on the hurricane deck for fifty first class passengers. The propelling machinery consists of a three cylinder triple expansion engine, with cylinders 28, 46 and 75 inches in diameter, with a common stroke of 48 inches. Four Scotch boilers, 15 feet in diameter, supply steam at 180 pounds pressure.

Steamer W. W. Brown.—The steamer *W. W. Brown*, second of six freight steamers being built for the United States Transportation Company, was launched from the yards of the South Chicago Ship Building Company on February 1st. The vessel will be 366 feet long over all, 340 feet between perpendiculars, 48 feet beam and 28 feet depth, and will cost $220,000.

Steamboat William G. Payne.—On February 8th, the steamboat *William G. Payne*, built for the New York and Bridgeport line, was launched from the yard of Harlan and Hollingsworth Company, Wilmington, Del. The general dimensions of the *Payne* are: Length over all, 257 feet; on water line, 240 feet; beam at water line, 36 feet 10 inches; depth molded, 14 feet 6 inches; draft, 8 feet. She is intended for day service on Long Island Sound, and can accommodate 1,800 passengers. A compound, inclined cylinder, direct acting engine is installed, with cylinders 35 and 72 inches in diameter and a stroke of 72 inches, driving feathering paddle wheels 19 feet diameter with nine buckets, 10 feet 6 inches long. Four Scotch boilers, 10 feet 6 inches long and 12 feet in diameter, built for the pressure of 140 pounds, will furnish steam.

Schooner Jennie R. Dubois.—On the 11th day of February, there was launched at the yard of the Holmes Ship Building Company, West Mystic, Conn., the five-masted schooner *Jennie R. Dubois*, built for the Sutton fleet, and to be commanded by Capt. E H. Smeed, of Providence, R. I. The measurements of this vessel are: Over all, 249 feet; depth, 26 feet; breadth, 46 feet; net tonnage, 1,942, and gross tonnage, 2,227. She is capable of carrying in her holds over 3,500 tons of coal, and could carry more than 2,000,000 feet of lumber. She has three full decks, the holds being respectively 12, 8 and 16 feet in depth, four cargo hatches and three deck houses. The forward deck house, which is 22x23 feet, is used for an engine room and forecastle, the midship deck house is 14x17 feet, and contains the cook's galley and stateroom and the second officer's quarters, and the after deck house, 33x28 feet, is divided into several rooms, containing the captain's stateroom and quarters, and also spare staterooms, bath and toilet rooms. The ground tackle for this vessel consists of one patent Baldt stockless anchor, weighing 7,250 pounds, and one ordinary anchor of 6,000 pounds. The windlass for hauling the anchors and chains was made by the Hyde Windlass Company. The engine is a thirty horse-power, and so arranged that it can be used for hoisting the cargo when desired. She is well arranged with all the most modern facilities for the handling of cargoes. There are three powerful wrecking pumps on board, one 6 inch, one 4 inch and one pair of Adair steam pumps, which, together, are capable of throwing from 6,000 to 8,000 gallons of water per minute.



SCHOONER JENNIE R. DUBOIS

Steam Yacht Quickstep.—On March 10th the composite constructed steam yacht *Quickstep*, built for Fred Grinnell, Fairhaven, Mass., was launched from Herreshoff's yard at Bristol, R. I. Length over all is 122 feet; on water line, 104 feet; beam, 18 feet; contract speed, 15 knots.

Steam Yacht Turbese. — There was recently launched from the Greenport Basin and Construction Company, at Greenport, N. Y., the handsome steam yacht *Turbese*, for Mr. A. Schwartzman, of New York. The general dimensions are: Length over all, 145 feet; on water line, 122 feet; beam, 17 feet 6 inches; draft, 7 feet 3 inches. She is built of wood throughout.

Steam Yacht Rheclair.—There was recently launched at the Burlee Dry Dock Company, Port Richmond, S. I., the steam yacht *Rheclair*. She is of the following dimensions: Length over all, 215 feet; on water line, 183 feet; beam, 27 feet; depth to main deck 13 feet. The yacht was designed by Messrs. Tams, Lamoine and Crane, New York city, for Mr. D. G. Reed.

Steamer Berkeley.—On March 7th the steamer *Berkeley*, of the Old Dominion Steamship Company, was launched from the yard of Wm. R. Trigg Company, Richmond, Va. The *Berkeley* is for night service on the James River between Richmond and Norfolk, is 213 feet long, 36 feet beam, 17 feet deep and will carry 500 tons cargo on a draft of 12 feet. There are accommodations for 54 first-class and 48 steerage passengers.

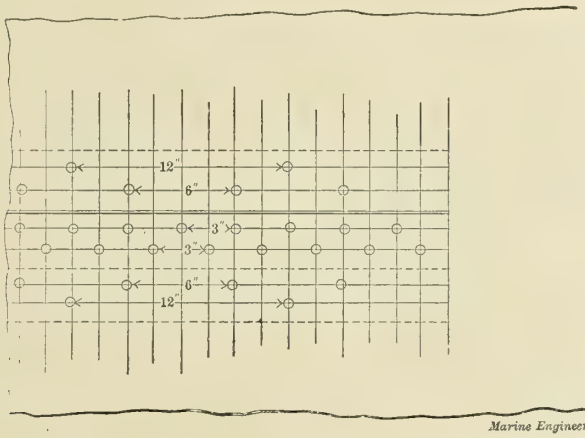
Steam Yacht Noma.—Messrs. Tams, Lemoine and Crane are the designers of the steam yacht *Noma*, which was launched recently at the Burlee Dry Dock Company, Port Richmond, S. I., built to the order of Mr. W. B. Leeds. The ship is of steel, twin screw, and of the following dimensions: Length over all 263 feet; on water line, 226 feet; beam molded, 28 feet 6 inches; draft, 14 feet. Triple expansion engines are designed to develop 4,000 horse power. They are of the four cylinder type, 17, 27, 32 and 32 inches in diameter by 24-inch stroke. Six water tube boilers will supply steam. The guaranteed speed is 18½ knots.

QUERIES AND ANSWERS.

Q.—A boiler is 54 inches in diameter, 5-16 inch sheets, 50,000 pounds T. S., with a lap joint and a strap on the inside, same thickness as shell, 3-4 inch rivets pitched 3 inches, 6 inches and 12 inches. The joint is just the same as a common lap joint double-riveted, with rivets pitched 3 inches, except that there is a strap on the inside of this joint, as shown in the sketch, and two rows of rivets on each side, the second row pitched 6 inches and the third row 12 inches.

I would like to know how many shear there are in 3 inches and how many in 6 inches, and how much strength this strap adds to the joint, and how to find it. J. T. F.

A.—It should be understood that the figuring of joints like these is very much a matter of judgment. Regarding the number of sections in shear you can easily count up that in 12 inches there are, reckoning on one side, three sections in single shear and eight in double shear, while on the other side all eleven are in single shear. Since this would then be the weaker side we may take the eleven sections 13-16 inch diameter. This gives 11 x .5184 = 5.70 inch. This at 40,000 pounds would give 228,000 pounds as the strength in shear for 12 inches of the joint.



LAP JOINT OF BOILER.

For the plate we have an area 5-16 x 12 = 3.75 inches. This at 50,000 gives 187,000 pounds. This shows that the shearing strength of the rivets is therefore greater than the tensile strength of the corresponding original or full section of plate, and therefore that there is an excess of rivet section in the joint.

If the row of rivets spaced 12 inches were omitted we should have in 6 inches five sections in shear. This would give in the same way as above, a shearing strength of 103,880 pounds. The corresponding plate strength would be 5-16 x 6 x 50,000= 93,750. This shows that even with the outer row omitted there is still an excess of rivet section.

Turning now to the plate the question of the efficiency and of the strength so far as the plate is concerned depends solely on where we may expect the plate to rupture. If, for example, it could be expected that rupture could be kept to the outer row of rivets spaced 12 inches, then the efficiency would become (12—13-16) ÷ 12 = 93 per cent. This, however, is out of the question, and, in the opinion of the writer, the very most that could be done would be to keep the fracture, perhaps, along the row spaced 6 inches. This would give an efficiency (6—13-16) ÷ 6 = .86.

If the strap were not there, the joint becomes a plain double riveted lap. In 3 inches there are two sections in shear giving a shearing strength of 41,472 pounds. The corresponding section of plate has a strength of (3 — 13-16) x (5-16) x 50,000 = 34,000. This again shows an excess of rivet section. The real strength is therefore that of the plate. For the plate we have an efficiency (3—13-16) ÷ 3 = 73 per cent.

It appears, therefore, that without the strap and as a plain lap joint the efficiency will be about 73 per cent. With the strap this becomes raised possibly to 86, though this might be considered as more than probabilities would warrant.

Q.—Will you kindly give me a thorough and accurate rule for working the horse power of a boiler of the following dimensions:—

Diameter of boiler	54 inches
Length of shell	84 "
Diameter of furnace	26 "
Length of furnace and tubes	70 "
Diameter of tubes	2 "
Number of tubes	80 "
Sq. ft. heating surface	284 "
Length of grates	42 "
Diameter of dome	26 "
Height of dome	26 "

J. R. S.

A.—The term "Horse Power of a Boiler" has very uncertain meaning. Power, it must be remembered, is developed at the engine from the heat in the steam furnished by the boiler. Some engines will develop a horse power for one hour from the heat in, say, 15 pounds of steam. In others more economical, not more than 12 or 13 pounds would be required, while in others less economical, the steam required will rise to 20, 30 or 40 pounds and over. The actual power which can be gotten out of the boiler depends, therefore, entirely on the engine with which it is coupled up. The boiler which you specify has about 7.28 square feet of grate surface and 284 feet of heating surface. This gives a ratio of about 39 to 1. The boiler should therefore show good economy, or a good return per pound of coal burned. With a good rate of combustion you should be able to burn 20 pounds of coal per square foot of grate per hour. This would give a total combustion per hour of 145.6 pounds of coal. With good economy each pound of this coal should evaporate about 9 pounds of water into steam. This would give 1310.4 pounds of steam per hour. With an engine using 15 pounds per indicated horse power per hour this would give steam for about 87 indicated horse power. If the engine required 20 pounds per indicated horse power per hour it would furnish steam for about 65 indicated horse power only; and if the engine required 30 pounds per indicated horse power per hour, only about 48 indicated horse power could be provided. If, on the other hand, the draft were poorer and less coal were furnished, less power proportionately could be developed, and similarly with more coal, more power; though with the higher rates of combustion the evaporation per pound of coal would decrease somewhat.

From these remarks you will easily see that the horse power of your boiler is a very uncertain thing and cannot be told from the dimensions of the boiler alone.

It may be mentioned that boilers are sometimes rated according to what is often termed "Boiler Horse Power." This is simply horse power based on a certain number of square feet of heating surface per indicated horse power. The figures usually taken are 10 or 12. According to this the boiler horse power of your boiler would be 28.4 or 23.6, according to the number taken. It should be observed that this has no particular or necessary relation to the actual indicated horse power which can be provided with steam from the boiler. In good practice 2½ to 3½ square feet is an ample allowance per indicated horse power.

Q.—Will you please tell me what regulations, if any, control the passage of ships laden with oil through the Suez Canal? H. D. F.

A.—In replying to the above question we make the following extract of the regulations for the navigation of ships laden with petroleum oil in bulk, issued by the Suez Maritime Canal Universal Company:

Any ship laden with petroleum oil in bulk, arriving before any port of access to the Canal, must make herself known by flying at the mizzen one of the following signals:

BY DAY: A red flag above one ball.

BY NIGHT: A white light beneath two red ones.

When the ship goes through the Canal, she must keep the above signals flying during the whole of her transit.

Before the ship enters the Canal, the Captain must sign and hand to the officials of the Company the following declaration:

DECLARATION.

I, the undersigned,.....commanding the ship .....laden with petroleum oil in bulk and belonging to..... owners, do hereby declare, on behalf of the said owners, as follows:

1. This ship is specially classed for the carriage of petroleum oil in bulk in class:*

✠ 100 A1 at Lloyd's in London;

✠ One 3/3 I. I. in the Bureau Veritas;

✠ 100 A4 in the Germanic Lloyd (Berlin);

2. No single tank in the ship has a cubic capacity greater than 500 tons measurement (being tons of 2.83 cubic meters, or 100 cubic feet English) nor can discharge its contents into any adjoining tank through any aperture or want of continuity whatever of its walls;

3. The petroleum oil contained in her tanks is solely refined petroleum of a uniform quality, no sample of which taken at the port of loading shall have given a flashing point below 23 degrees Centigrade (73 degrees of Fahrenheit's thermometer), this temperature having been ascertained conformably with such process of close test as may be recognized and made use of in the petroleum oil trade, as for instance the Abel test or any other close test of a not lesser degree of accuracy;

4. The petroleum oil contained in any of the ship's spaces other than her tanks has a flashing point not under 66 degrees Centigrade (150 degrees of Fahrenheit's thermometer), this temperature having been ascertained as prescribed in paragraph 3.

(Date)

....

Commanding Officer.

* Strike out the names of the offices where the ship is not entered.

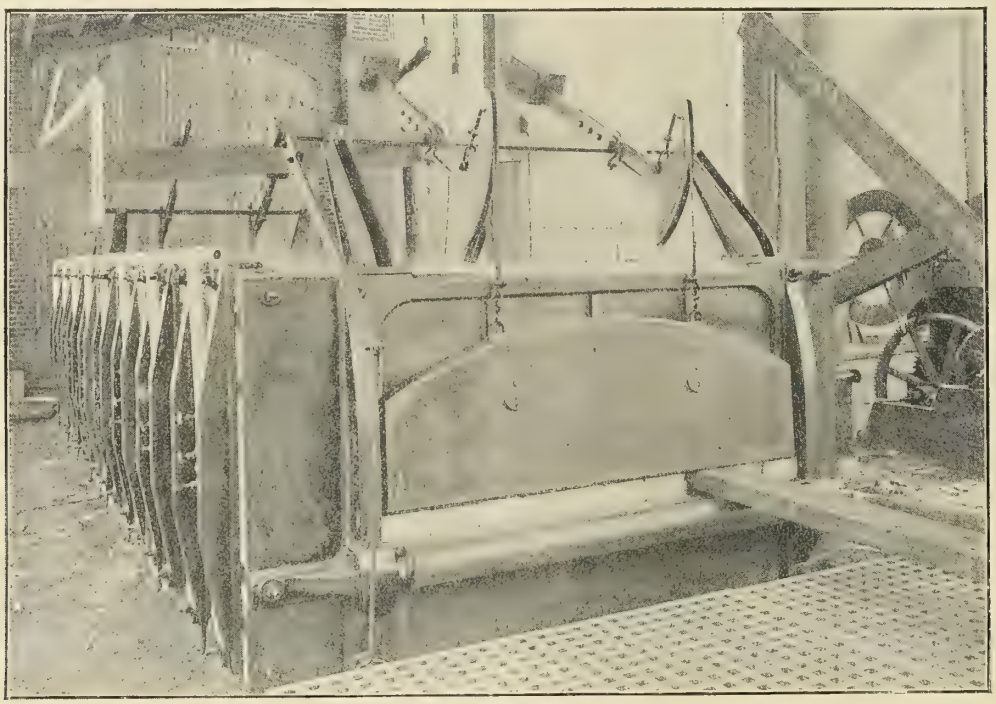
Tank Ship Atlas.—On January 11 the Standard Oil Company's tankship Atlas was launched from the yard of Arthur Sewall and Company, Bath, Me. She is 332 feet long, 45 feet beam and 26 feet deep and is for the oil trade.

ENGINEERING SPECIALTIES.

Plate Furnace with Oil Fuel.

Owing to the general interest in the use of oil fuel among manufacturers in connection with cheap Texas oil, the accompanying illustration of a plate-heating furnace for shipyard work, operated by oil fuel, is of special interest.

Several burners are placed along the side of the furnace shown at the left in the cut, and are supplied by steam from the piping above, and by oil from the piping below led underground from the oil pump. This pump, not shown in the illustration, pumps the oil from the storage tank through a heater mounted in the base of the pump and delivers it at about 170 degrees temperature and 70 pounds pressure to the service lines.



OIL-BURNING PLATE FURNACE.

For regulation there are two valves at each burner; the upper one is a steam valve, and the second one, which is at the burner, is the oil valve. A lower valve is used for turning on or off the supply of oil. The oil is blown into the furnace and atomized by the steam, and the draft, thereby caused, draws in through an opening below the burner, air of sufficient quantity for completing combustion. Combustion takes place in the furnace, where a uniform heat can be maintained. Plates can be quickly and uniformly heated in this furnace without the formation of scale. Another advantage is that these furnaces require no chimney.

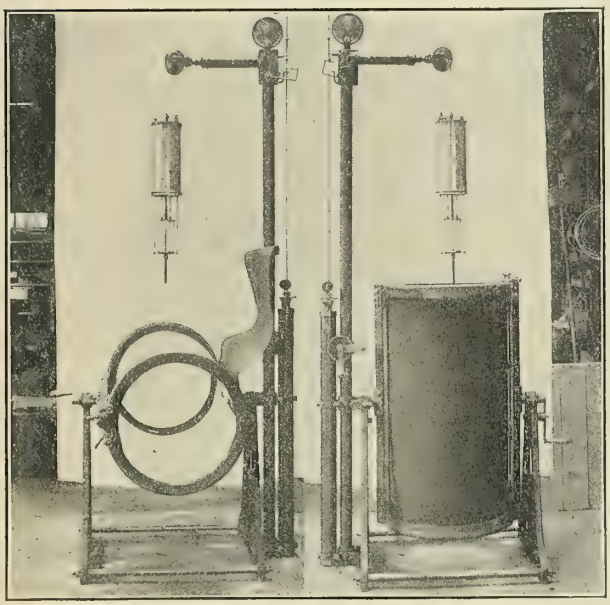
This furnace, and also rivet heaters, angle and forge furnaces of various forms, are built by the Rockwell Engineering Company, 26 Cortlandt street, New York city. The company also has a system for operating marine boilers on shipboard with oil fuel, and has equipped a number of vessels during the past few months with this system.

Electric Blue Print Apparatus.

The accompanying illustration shows a simple but efficient electrical device for making blue prints or photographs indoors at any time of day or night, thus allowing each user to be entirely independent of sunlight.

The machine is self-contained in all of its operations, and does not require an expert to erect it after receipt by purchaser. All machines are tested and adjusted before leaving the factory, ready to operate.

The apparatus consists of a transparent cylinder, rotatably mounted in a portable frame, having means whereby the cylinder may be locked in either a vertical or horizontal position. The lamp is suspended by means of a standard with horizontal arm, this standard being fastened to the extension of the portable frame.



APPARATUS FOR MAKING BLUE PRINTS BY ELECTRIC LIGHT

The lamp (or light) acting as a counter-balance to the piston, is gradually lowered by being attached to the piston rod, which is provided with a valve, for the purpose of regulating the downward speed of the lamp. The range of speed can be adjusted anywhere between five seconds and twenty minutes, depending on the degree of sensitiveness of the paper used.

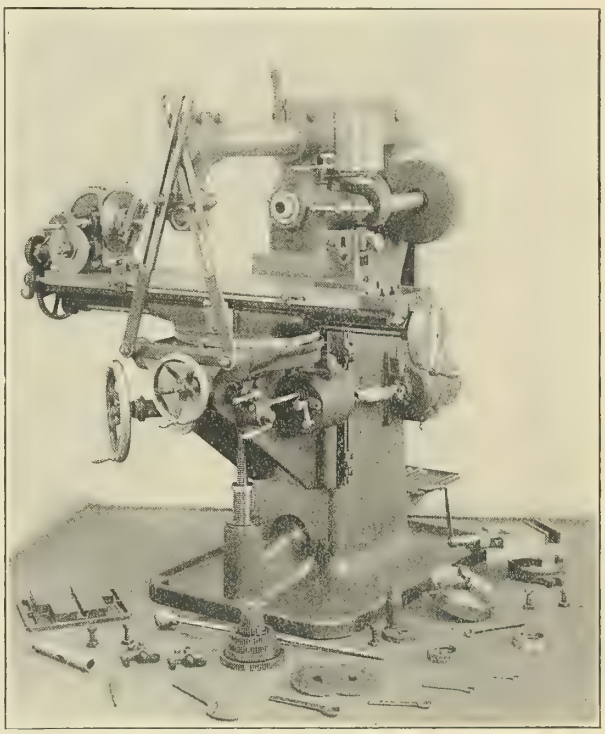
When the lamp (or light) has reached its maximum downward movement, the supply of current is automatically cut off, and the automatic "cut out" is held in this position until the lamp is returned to its normal position, and may be "cut in" at any point where to the lamp may have been lowered by the operator.

The apparatus, which is made in various sizes, may be placed anywhere in a room, and the user will soon determine the proper exposure with reference to the grade of paper employed.

For further information, application may be made to the Elliott Electric Blue Print Company, 723 Liberty avenue, Pittsburg, Pa.

Universal Milling Machine.

The Brown and Sharpe Manufacturing Company, Providence, R. I., has recently placed upon the market a new design of Universal Milling Machine, which is shown by accompanying engravings and embodies new features that are of interest. A feature that attracts attention is the entire absence of the usual feed pulleys and belts, thus eliminating the overhanging brackets and other appurtenances necessary to a belt-driven feed. The variable feeding mechanism, being an entirely new feature, a description will be of interest. It is driven from the main spindle of the machine by a chain and sprocket wheels. The gearing of the mechanism itself being spur gears, and the drive to the feed-clutch gears in the knee being also by spur gears, all with

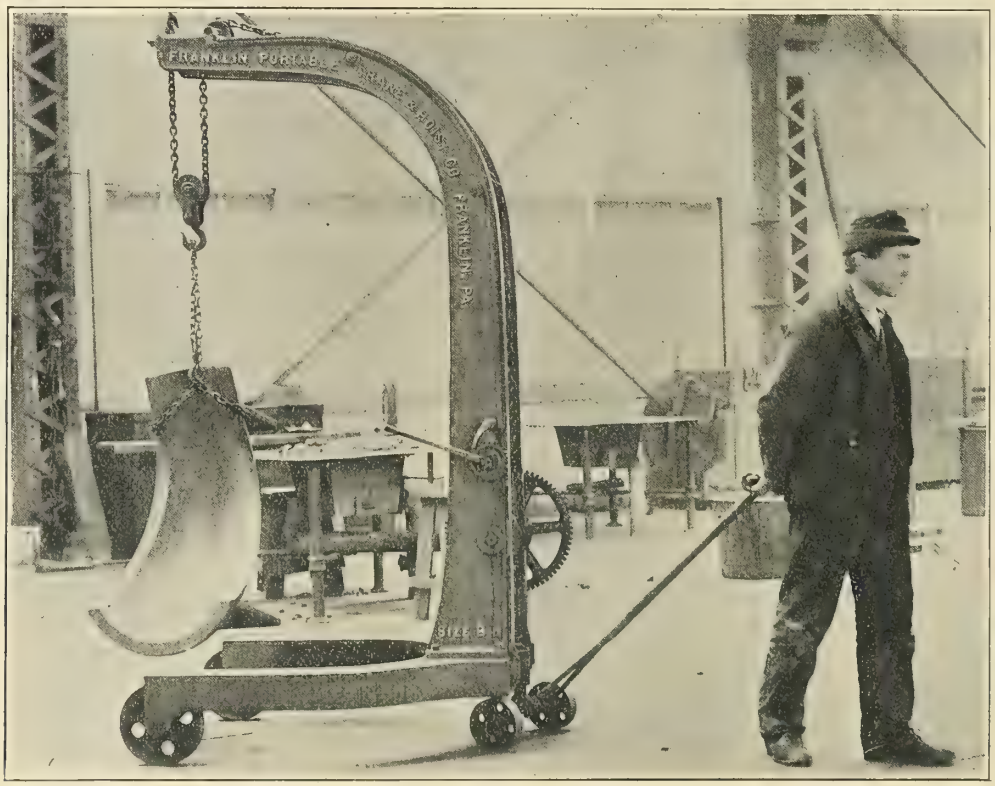


UNIVERSAL MILLING MACHINE

properly arranged bearings, the loss of power by friction is slight, thus making the efficiency unusually high. It is designed to obtain a wide range of feeds, varying in geometrical progression, fully covering all the requirements of modern milling machine practice. The mechanism, as a whole, is self-contained, and care has been taken to insure ease and quickness of manipulation. The drive is from the main spindle of the machine by chain to the sprocket wheel that drives the shaft. This shaft carries the two main driving gears, one gear running directly upon the shaft and the other upon the hub of this gear, these in turn being driven by clutches. The power is transmitted from either of the gears to the intermediate shaft carrying the two sets of gears, which are keyed into position on the shaft and transmit the power to a series of loose gears mounted to run one upon the other. This method of mounting insures long bearing surfaces for each gear.

The power is transmitted from the variable feed

mechanism through the telescopic shaft to the gear case. This case contains the feed reversing mechanism which is operated by a lever, the movement of which serves to start, stop or reverse all feeds. To guard against accidents or breakages, which are inherent in any positively driven mechanism, a safety screw is placed in this telescopic shaft, which is intended to break under any unusual strain and prevent damage to the machine mechanism. The table is heavy in proportion to the capacity of the machine, and provided with T slots sufficiently deep to insure strength. The arc through which the table can be swung is amply long; for example, on the No. 2 machine, this arc is 286°. braces are furnished for tying the arm rigidly. The arbor support, besides carrying a bronze bushing for the arbor bearing, also carries an adjustable center that is always in position. In the design of this machine great care has been taken to secure the greatest efficiency, together with extreme accuracy and simplicity. The parts are so arranged as to be compact and easy of access. As to the rigidity of the machine attention is called to the disposition of the metal, there being no excess where not needed, and when great strength is required the metal will be found to be suitably disposed; for example, the uprights that support the spindle bearings, and the overhanging arm, are solid and rigidly tied.



A PORTABLE CRANE IN USE.

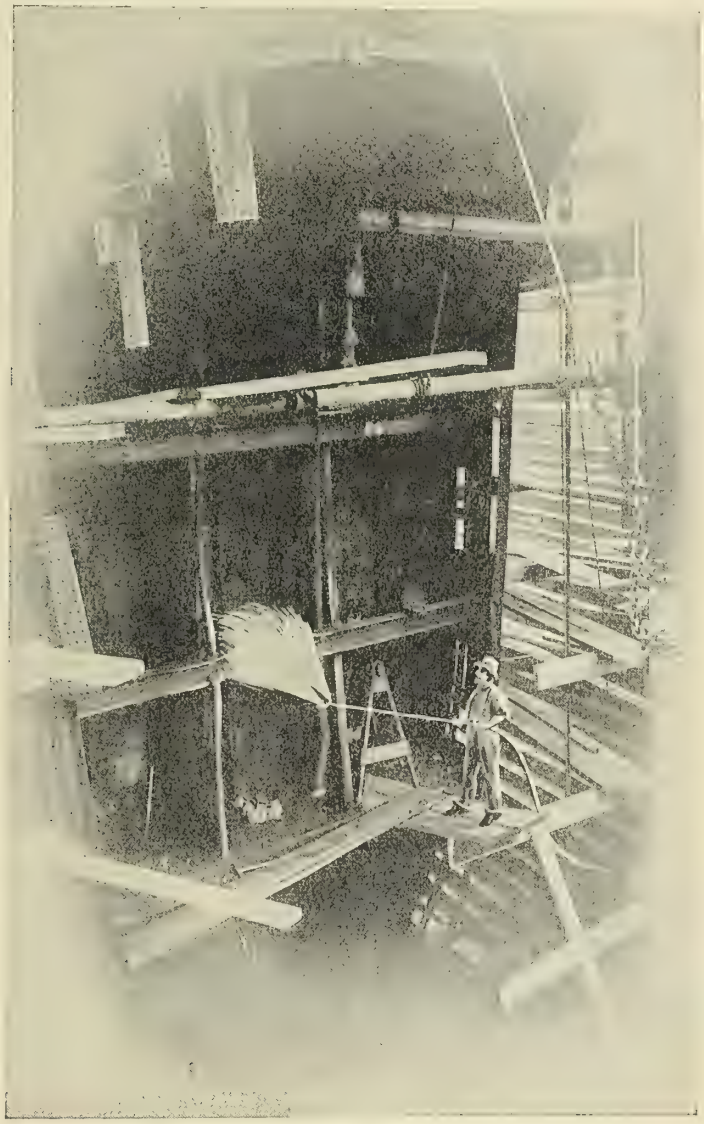
The power feeds can be used with the table set at any angle to 53°, on the No. 2 machine, either side of zero; this is an exceptionally wide range and greatly increases the capacity of the machine for automatically cutting spirals. The telescopic knee screw is another important feature, the advantages of which are readily appreciated, as it does not extend below the base, and the machine can be placed at any point upon the floor, regardless of girders or foundations. The thrust of this screw is taken by ball bearings. The clamping arrangement for the overhanging arm is worthy of attention; it is simple and efficient. One lever, shown at the front of the machine, operates a shaft with rack teeth that engage the nuts on the clamping bolts, thus clamping both ends of the arm with one movement of the lever. The arm being a straight steel bar makes it possible to place any of the regular attachments in position without the necessity of removing the arm. Arm

Portable Crane and Hoist.

A portable hoist built especially for the quick hoisting and transportation of machinery of any shape or weight up to 6,000 pounds, has been placed on the market by the Franklin Portable Crane and Hoist Company, Franklin, Pa. It is a very handy machine and can be used in almost inaccessible places where overhead cranes cannot reach. In every shop there are many spots not covered by cranes or industrial railroad, but the Franklin is serviceable wherever it can be wheeled. One man can operate it, hoist or lower the weight, and transfer it about the shop or yard, and do the work of three with ordinary tackle and hand car. The handle is rigid in the axle, which is a cam, and when raised against the arms the weight of the machine rests on the wheels and axle forming a strong and efficient brake. These cranes have been used satisfactorily for many months by the New York Shipbuilding Company.

A Portable Heater.

A very useful little machine for shipyards, to be used wherever temporary heat is required, is the Ferguson portable heater, illustrated in the accompanying drawing. It consists of a tank mounted on wheels and a long length of hose leading from a compressed air supply pipe to the portable burner. At the half way length of the hose is placed the oil tank and the oil regulating valve. Compressed air enters the regulating valve and there mixes in such proportion with the oil that a perfectly combustible mixture is obtained which is carried through the remaining length of the pipe to the burner. This mixture of oil and air is not affected by friction and the oil will not deposit in the pipe. The mixing valve can be regulated so as to give a greater or less amount of oil, or no oil at all, when it is desired to blow out the pipe. There are many kinds of work in which the Ferguson portable heater can be used, as for heating and expanding a propeller when it is to be removed, expanding socket couplings, etc.; but it is in hull repair work that its greatest field of service is found. Where bent frames and plates are to be straightened this work can be readily done by applying the heat from one of these machines to the bent member and forcing it out in place by strong backs. The cost and time required to heat these plates or angles by the ordinary method is very great in comparison to that when this machine is used. Plates in any part of the ship can be straightened. The discharge pipe from the oil tank can be carried down into the holds and to the most inaccessible places; for the mixture obtained by the valve in the oil tank is such



A PORTABLE HEATER FOR USE IN SHIPYARD REPAIR WORK.

that it can be carried through 200 feet of hose without being affected.

The length, direction, and intensity of the flame are under the complete control of the operator, and a great saving in both time and expense of fuel is secured by the use of this heater. Further inquiries should be addressed to W. M. Simpson, Old Colony Building, Chicago, Ill.

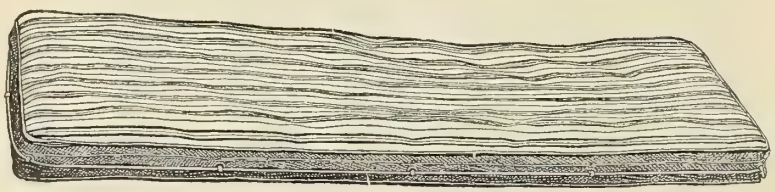
Pneumatic Mattresses and Cushions.

A most important consideration on any vessel, and especially on yachts and launches, is to make life as comfortable and as safe as possible. There is perhaps no device that comes nearer doing this than pneumatic cushions and mattresses. The illustration herewith shows the type of Perfection air mattress manufactured by the Mechanical Fabric Company, Providence, R. I. Mattresses and cushions of the Perfection type add greatly to the safety on board a vessel of any kind, for they are equal to ordinary life preservers, and have many advantages over them, in that they are always at hand and are decidedly useful and ornamental.

On each mattress there is a line to be used for life-saving purposes in case it is necessary to use the mattress in this way. It is claimed that one of these mattresses will keep from sinking as many people as can hold on to the line. Cushions are made in the same way that the mattresses are, and are especially desirable for use in cock-pit seats as well as in chairs and in any place where cushions are needed. Even a small cushion is claimed to have sufficient buoyancy to support as many people as can hold on to it.

The comfort of the mattress can readily be shown by the manner in which it is made. The foundation is strong cotton duck, which is coated with a pure rubber compound, vulcanized, thus making it perfectly air tight and odorless.

The mattress is furthermore properly stayed, so that the shape is always maintained. For covering, anything commonly employed for this purpose may be used, giving them any appearance desired.

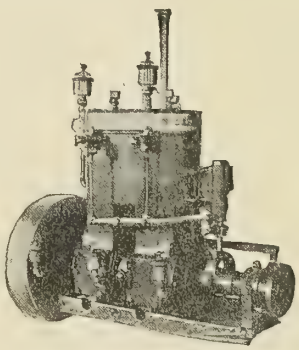


AIR MATTRESS.

Another special advantage of these goods at sea is that they resist moisture, as there is nothing in or about them to absorb dampness or in any way be affected by water. Other important claims are that they are vermin proof, and that they can be used for a great many years with an occasional change of ticking or covering, as there is nothing about them to absorb odors. When inflated they will remain in excellent condition for many months, and, as in the case of yachts, should it be desirable to lay them away for the winter, they can be deflated and stowed away in small lockers. Another important feature in connection with the use of these mattresses is that no springs are needed.

Twin Cylinder Gas Engine.

The Lake Shore Engine Works, Marquette, Mich., are building a twin cylinder engine for small marine work which embodies many excellent features. These twin cylinder engines are cast in one piece, making the two cylinders, crank chambers, bearings, and base plate one solid casting, thus reducing to a minimum the possibility of vibration due to loose joints, etc. The new igniters are driven from an eccentric which operates both the igniters from one rocker arm, and the pump is also driven direct from the same eccentric.



TWO CYLINDER GAS ENGINE FOR LAUNCHES.

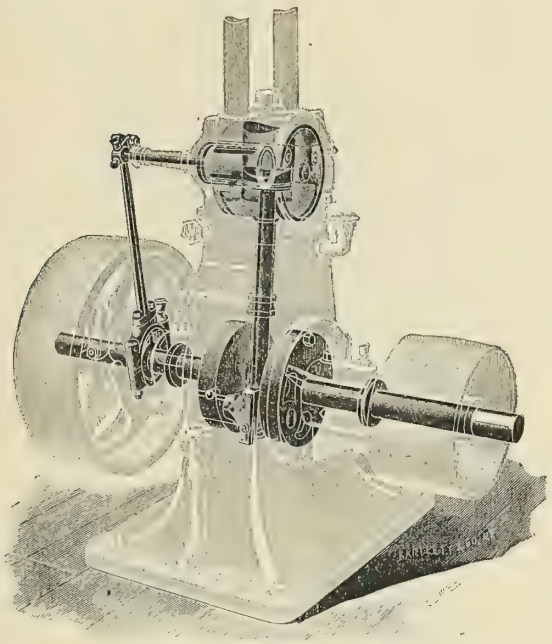
The new type of engine has the fly wheel turned all over, inside and out, and is perfectly balanced, and the balance of the reciprocating parts is also taken care of. Instead of having one cylinder head covering both cylinders, a separate head is fitted for each cylinder, so that if it is necessary to get into one cylinder only one head has to be removed. The firing plugs are removable from the cylinder head without taking it off, and if the insulation gets out of order a new plug entirely can be fitted in less than thirty seconds. All the journals on this engine are phosphor bronze, and every joint is ground metal to metal, with the exception of under the cylinder head, where a metallic gasket is used. The pistons are all ground to a fit with the bore of the cylinder, which is made to a standard gauge with standard reamers, and afterward burnished so as to make as perfect a fit as possible.

It is the aim of the builders to continually improve the engine wherever experience has shown such to be possible, rather than to make an engine which will sell commercially in competition with those of other builders.

ENGINES FOR DIRECT CONNECTED SETS.—III.

High Speed Engines.

The Case engine herewith described has many novel features, and the type is remarkable for simplicity, direct action, compactness, lightness of moving parts, automatic regulation and lubrication. This engine has now been manufactured for ten years, and has a great diversity of application. The accompanying illustrations show, in Fig. 1, a transparent view of the engine illustrating the working parts, and in Fig. 2 the engine direct connected to a generator. As seen in Fig. 1, the piston is direct connected to the crank pin without the intervention of the connecting rod, thus eliminating many parts and wearing surfaces of the common engine. The design is materially lightened, resulting in the attainment of high speed without injurious vibration, and at the same time the increased speed reduces



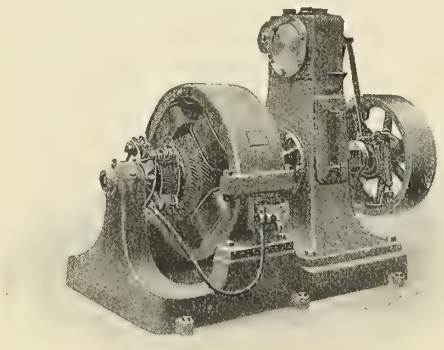
TRANSPARENT VIEW OF CASE ENGINE.

the necessary size of cylinder. By eliminating the connecting rod the height of the engine is also diminished.

One end of the piston is thus connected direct to the crank pin, and the other travels back and forth through the bore of the cylinder, which latter, by reason of its shape, is free to turn in its casing and is rocked by the vibrating piston rod through an arc sufficient to open and close the steam and exhaust ports on its face. A long sleeve screwed into and forming a part of the cylinder, and through which the piston-rod works, imparts the rocking motion to the cylinder.

The upper end of the cylinder is open, so that steam admitted for the downward stroke acts from the head of the piston to the surrounding casing or steam chest, and therefore there is no steam thrust tending to cause friction of the cylinder against the casing. The lower end of the cylinder is closed, but the same thing is accomplished for the upward stroke by the admission of a film of steam to a small balancing chamber hollowed out of the cylinder. By these ingenious methods the friction required to rock the cylinder is reduced to a minimum. This rocking motion is slight, and although the wear is very small, whatever may occur may be taken up by two taper keys which expand the cylinder. The casing surrounding the cylinder is chambered out, forming a steam jacket, so that an equal degree of expansion is carried to all parts of the cylinder.

The action of the fly-wheel governor does not diminish the throw of the valve, but rotates the eccentric on the shaft, and thereby gives the valve the right amount of lead over the crank. The cut-off valve is of the plug type, perfectly balanced and made with a slight taper so that it can always be kept tight. The lower half of the case of the engine forms a reservoir for oil and water, into which the crank pin dips at each revolution. The lubricant is conveyed at every stroke automatically by pockets in the crank disks.



HIGH SPEED ENGINE AND DYNAMO.

The Case engine is manufactured by the New Britain Machine Company, New Britain, Conn., and is built in several types to meet the various demands for light-running high-speed engines.

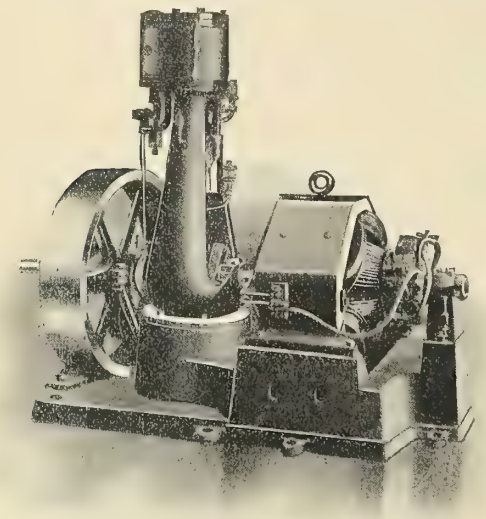
Racine Automatic Engines.

The accompanying illustration shows the Racine Vertical Automatic Engine made by the Racine Hardware Company, Racine, Wis., direct-connected to a generator, and intended for lighting, storage battery or power service. Special attention is called to the neatness of design, compact arrangement and rigid and substantial mounting of the entire unit. These engines are eminently adapted for marine lighting, and for use in all places where economy of space and noiseless operation is desired.

The engine is of the piston valve type with rings in both valve and piston. The valve and governor are perfectly balanced and all moving parts are adjustable. The crank shaft and connecting rod are steel forgings. The crank boxes are babbitt lined, insuring cool running qualities and freedom from cutting. The shaft is supported by a broad out bearing, beyond the governor wheel, which is mounted on the extended base of the engine, thus insuring perfect alignment and additional steadiness of motion. A very important feature in an engine for operating electrical apparatus is the regulation. This governor is of the inertia type, very simple in construction and

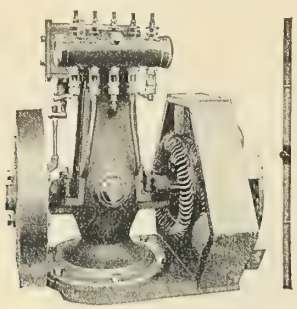
yet so sensitive in operation that a regulation within one per cent from no load to full load is guaranteed. An automatic oiling system is provided, which permits of long continuous runs, as all moving parts can be lubricated while the engine is in operation.

On all direct-connected engines there is furnished a shield on the generator side, which makes the engine practically inclosed and protects the armature from oil or water. In the illustration the shield has



SINGLE CYLINDER RACINE AUTOMATIC ENGINE.

been removed, showing the working parts of the engine. The specialty of this company is the manufacture of high-grade automatic engines of the vertical type, in sizes from 2 to 37 horse power inclusive.

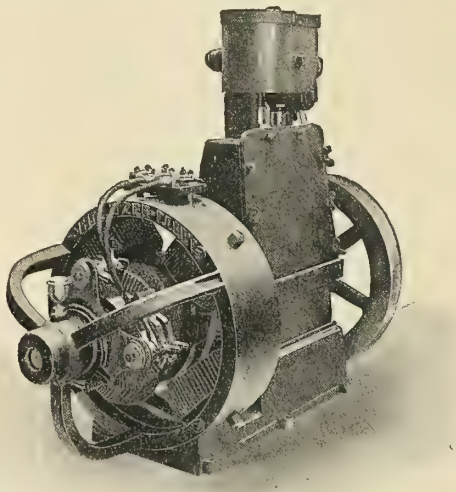


ENGBERG'S SMALL GENERATING SET.

Small Direct Connected Sets.

To meet the increasing demand for small direct-connected generators there has been placed on the market by Engberg's Electrical and Mechanical Works, St. Joseph, Mich., a new type of machine of very compact design. As will be seen by the cut, these generating sets are very small, occupying a space of 18 by 24 inches only. They are, however, being designed and built with as much care as the largest machine, the workmanship and materials being of the very best.

The inclosing of the connecting rod, etc., makes the machine very clean and dust proof. It spatters no oil about. Other very desirable features of this size generator are the automatic cut-off governor and balanced piston valve which insure economy and close regulation, doing away with the old style of cumbersome belted throttling governor. All the bearings are large, and a complete sight-feed oil arrangement connects with all the bearings. This generator was designed for places where space and weight are considered and a small number of lights are necessary besides the search light, such as on steam yachts, tugs, etc. The generator is of the six-pole type wound for 50 volts, thereby doing away with a loss of current in the resistance coils which are necessary on a 110-volt circuit for search light use, and otherwise wound for 110 volts when wanted for that system.



1. 5 K. W. GENERATOR.

Marine Generating Set.

The marine generating set shown in the accompanying cut has been designed to meet a demand for a small and compact set, extreme lightness being especially desired. Aluminum is used very extensively in the construction in portions where great strength is not required. The dynamo is of the multipolar type, the ring and poles being of a high grade of wrought iron, selected on account of its high permeability. It is reduced in weight to as great an extent as can be done without interfering with the performance of the machine. The armature is of the drum-wound type and well laminated. It is mounted upon the engine shaft. The brush holders are of the radial type, such as are used on all Holtzer-Cabot motors. Self-oiling and self-aligning bearings are used. In the cut the dynamo is shown in direct connection with a Herreshoff engine of a recent type, which has been brought out especially for this class of work. It will be observed that all working parts are completely enclosed and run in oil. The engine is of the slide valve pattern with throttling governor. This set weighs about 298 pounds and will supply 30 16 c. p. lamps or 5 watts output per pound weight, at a speed of 850 R. P. M. A line of these sets is being manufactured by The Holtzer-Cabot Electric Company, Boston, Mass.

THE PROFESSOR ON SHIPBOARD.

Story of an Attempt to Combine Theory with Practice.

BY C. A. MC ALLISTER, FIRST ASSISTANT ENGINEER, R.C.S.

CHAPTER IX.

In company with several of the passengers the Professor spent another delightful evening on shore, but as the ship was to sail early the following morning he reluctantly had to forego the pleasures of another comfortable night's sleep at the hotel. As they were rowed out to the ship in a shore boat, the Professor was much impressed with the beauties of the harbor at night. The sky was brilliant with innumerable stars and for the first time in his life he gazed upon the Southern Cross which was pointed out to him. The boat left a golden wake behind her, and each stroke of the oars seemed to make a swirling pool of molten gold, so pronounced was the phosphoresence of the sea water. The faint outline of the steamer could be discerned with the electric lights gleaming through her air ports. From several other vessels in the harbor faint sounds of singing could be heard, and the distant strains of an accordion, the sailor's favorite musical instrument, were wafted over the still waters. Arriving on board he found the Chief Engineer, who informed him that the repairs to the boiler would soon be completed and that they would sail at about five in the morning. When he awoke on the following morning he found that the ship was rolling around in the same old way, and he was brought to a realization that he was once more at sea and subject to the many vicissitudes of the deep. After he had finished his breakfast he strolled out on deck, where his attention was attracted to a group of the passengers standing near the rail engaged in an animated conversation. Listening a few moments to the trend of the remarks, he was surprised to learn that the subject under debate was whether the flying fish, which were at that time very numerous about the ship, actually flew or not. One dogmatic individual took the side that they did not fly at all, and that they simply "soared," as he expressed it. The Professor, after apologizing for breaking into the conversation, asked how it was possible for the small area of the fish's fins to support the weight of the body if the fish simply soared. Continuing, he remarked that the question whether these fish actually fly or not had been discussed at a meeting of a scientific society about twenty years ago. Several of the so-called scientists argued that it was impossible for the creatures to propel themselves through the air owing to the small size of the muscles of the pectoral fins. Their theories were completely routed by a paper read by an engineer officer of the U. S. Navy, wherein by mathematical calculations he demonstrated that it was not only possible but that they actually did fly, as it was shown clearly that "soaring" was an impossibility. This statement led one of the passengers to remark that marine engineers must be very intelligent men to discuss such subjects. To this the Professor replied that the profession of marine engineering was essentially one wherein common sense predominated, and that in his experience he had found that men educated and trained in this branch were enabled to grasp almost any subject and deal with it in an intelligent manner. The diversified problems which present themselves almost daily to sea-going engineers, and the celerity and originality with which they must be met, constitute a mental training which, said he, is calculated to prepare men for almost any walk in life. Continuing, he remarked that some of the most eminent men in the entire engineering profession are those who have served some time at sea. The Professor then cited a number of instances where former marine engineers had attained great prominence in various pursuits on shore. By the time the college man had finished his discourse, that group of passengers, at least, had a much higher opinion of the toilers below.

In the afternoon he was joined by the Chief Engineer, and the conversation drifted to engineering subjects. The Professor asked him how often they took indicator cards from the engine. "Well," replied the Chief, "I don't have them taken very often, as it is too much bother, and besides that I don't see what particular good it does anyhow." "You are mistaken there," replied the college man, "for in my opinion at least, one set should be taken every day. In that way only can you keep track of what your engine is doing. It is not so important to take them for determination of the horse power developed, but you can determine how your valves are set, and whether the valves and pistons are leaking. Of course there are a number of scientific facts to be determined from indicator cards, but for your purposes on board ship it is well to take at least one set every day, for future reference, if for nothing else. He then inquired if the ship was furnished with a set of indicators and the necessary gear for working them. He was informed that there was only one indicator on board, but that the gear was fitted to each of the three cylinders.

"Only one indicator," said the Professor. "Then I don't blame you much for not wanting to take indicator cards, as I have had some experience myself in shifting springs on a hot indicator. I don't see why the owners don't furnish you with a set of three indicators, as the additional first cost is very little when compared with the trouble it gives the engineers in taking a set of cards with a single indicator, not to mention the fact that it is impossible to accurately compute the horse power, unless the cards are all taken at practically the same time."

Continuing, he said: "I haven't seen your indicator gear, but if I was a betting man I would wager even money that the gear is not fitted correctly." "I don't know about that from your standpoint," replied the Chief, "but our gear is fitted in about the same manner as I have seen it fitted to many other steamers." Just to satisfy his curiosity the Professor walked down below in the engine room, and at one glance he discerned that the indicator gear was fitted, in common with a great many other merchant vessels, in a wrong manner. The reducing motion was, of course, taken off the cross-heads through the means of a short link, and an indicator arm pivoted on a stud screwed into the back column, the motion being transmitted to the indicator by means of a string looped over a pin screwed into the arm about 6 inches from the pivot. Returning to the deck he informed his brother that the gear was fitted wrong, just as he had expected to find

it. To a request from the Chief that he would like to have it explained to him wherein the gear was not accurate, his brother replied as follows:

"The most essential thing about an indicator gear is to have the motion of the revolving barrel exactly coincident with the stroke of the piston. That is, every point in the length of the card must correspond exactly to the similar point in the stroke of the piston, or otherwise you will not have an exact representation of the steam and expansion lines on your card. While it is true that for practical purposes a slight discrepancy does not make a great deal of difference, as long as you take indicator cards it is better to have them absolutely correct than to have even the slightest doubt concerning their accuracy. Now," said the Professor, as he pulled out a scribbling pad from his pocket, "here is the manner in which your gear is arranged.

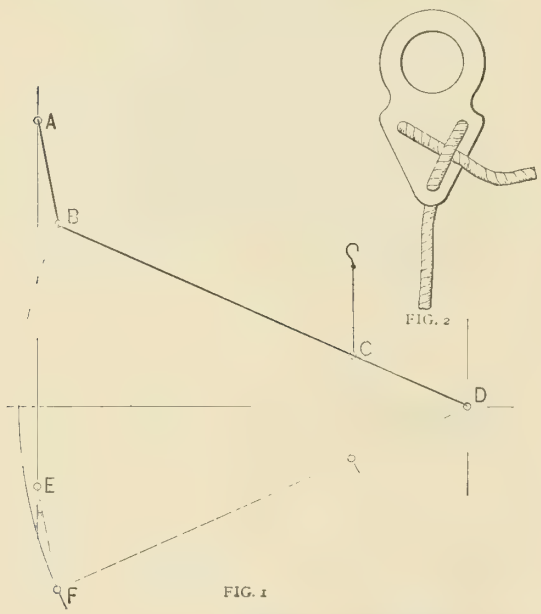


FIG. 1

FIG. 2

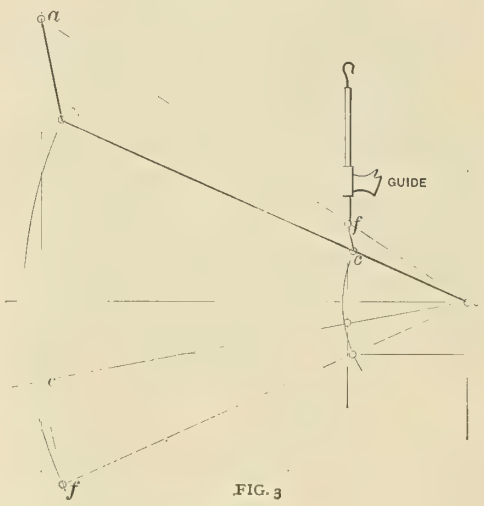


FIG. 3

A CORRECT AND INCORRECT FORM OF INDICATOR REDUCING MOTOR GEARS.

"A is the point on the cross-head of the attachment of the link A B, and B D is the indicator arm. At the point C the pin to which the indicator cord is fastened is screwed into the arm. Now, as you will see, the point A travels up and down on the straight line A E, representing the stroke of the piston. The point B travels on the arc of a circle which has D as its center. As you can easily see, this point B, while traveling on this arc, does not cover the same distance in a vertical direction as does the point A, which is going up and down in a straight line. Now the same can be said of the point C, which also travels on the arc of a circle, and hence does not impart a motion to the indicator barrel accurately coincident with the stroke of the piston.

"Here is how this difficulty can be overcome, and is the way that all indicator motions should be arranged:

"By fitting a small link to the indicator rod at the point C, and connecting the other end of it to a vertical rod guided as I have shown it, you will find that a correct motion is given to the indicator barrel. The length of the small link *c f* should be such that the point *f* is at the intersection of the line *a d* with the vertical line through the center of the rod, and hence is proportional to it. The links *a b* and *f c* will then be parallel, and as a result the point *f* will always have a precisely similar motion to the point *a*; that is, the barrel on the indicator will be given a motion in a constant proportion to that of the piston, which accomplishes the desired object."

"I can see the point of your argument," said the Chief Engineer, "but I really don't see that it makes much difference practically, only as you say, if we are going to have indicator gearing fitted, it might just as well be correct."

"Another good feature about this kind of a rig," continued the Professor, "is to have these vertical rods run up to about two feet below the indicators, and leave the top ends forged into the shape of a hook. The strings can then be attached to these hooks by the man using the indicator, without the bother of crawling down below and performing sleight-of-hand tricks every time he tries to loop the string over the pin on the indicator arm."

"By the way," said the Professor, "if you don't object I will go down below this evening after it gets cool and take a few cards off the engine."

His brother assured him that he would be very much pleased to have him do so, and that he would go down and help him.

After dinner was over that evening the Professor donned his overalls, which he had taken pains to have washed white while he was in port, and bravely marched into the engine room, not forgetful of his past experiences there. He was agreeably surprised to find that after sundown it was not quite so warm as it had been, and that the breeze coming down the ventilators kept the temperature of the engine room down to a moderate point. The Chief sung out for Barney to get

the indicator out of the store room. After considerable delay he managed to find it, all covered over with dust in an out of the way corner. Upon opening the box the Professor found, much to his disgust, that when last used the spring had not been removed and that the interior of the instrument had not been properly dried out and oiled. As a result the spring was quite badly rusted, sufficiently so to make it unreliable in recording pressures. The Chief inquired if there was not a rule governing the strength of springs to be used in indicators. To this the college man said that he knew of no rule applicable to all cases, but that in his opinion, for a triple expansion engine using a boiler pressure of 160 pounds per square inch, it would be a good proportion to use springs of 80, 40 and 20 pounds' strength respectively in each of the three cylinders. He further said that it was a good rule to select springs which would not give cards over two inches in maximum height, and that it was also a good idea to so arrange the reducing motion as to give cards of a uniform length of four inches. He also said that a 20 pound spring in the low pressure indicator would not give a card much more than one inch in height, but it was better to use a spring of that tension in order to prevent the pronounced vibration which would necessarily result from the use of a lighter spring.

Selecting the proper spring for a high pressure card, he fitted it in place and oiled the steam cylinder with some cylinder oil, remarking as he did so that it would be much better to use a lighter grade of oil, such as is furnished by the manufacturers with the instrument. A new piece of string was cut off the hank in the box and Barney was directed to loop it over the pin on the indicator arm, which he succeeded in doing after a number of efforts. The Chief gave the indicator pipes a good blowing out and then secured the instrument in place. The next thing was to adjust the string so as to give the barrel an even stroke at the ends. After making a number of new slip-knots this was finally accomplished. The Professor explained to his brother that it was a good scheme to have a small flat piece of brass with three holes bored in it so that the length of string could be more readily adjusted. To illustrate his remarks he made the sketch shown in Fig. 2.

The Chief promised to have one made for him, and remarked that he had seen such a device before, and that it was all right. The Professor next sharpened the pencil at the end of the indicator lever, saying as he did so that he preferred to use chemically prepared indicator cards upon which a black mark could be made with a sharp pointed brass screw instead of a lead pencil. Everything being ready the Professor drew the atmospheric line, calling his brother's attention to the fact that during this operation the lever on the indicator cock should always be so placed as to connect the interior of the steam cylinder with the atmosphere, as otherwise the leakage through the cock might affect the height of the line. After very dexterously taking several cards the Professor said that as it was getting rather late in the evening he would "turn in," but promised that on the next day he would have something further to say about the indicator cards themselves.

TECHNICAL PUBLICATIONS.

Marine Boilers, by L. Bertin, Director of French Naval Construction. Size 8vo., pp. 566 with 300 figures. Price 25 francs. Paris, E. Bernard & Co.

This book is the second edition of the well-known work published by M. Bertin in 1896 and which was made familiar to English and American engineers through the translation by Robertson. These works have become so well known through the first edition, both in French and English, that no extended notice of the book as a whole is called for at the present time, and it will be sufficient to refer briefly to the changes and additions.

In the amount of matter as compared with the first edition we find a notable increase, the total addition amounting to 130 pages, with an increase in the number of figures from 233 to 300. The added matter is distributed throughout the book and is intended to bring the work more completely down to date, and to amplify various topics which have increased in importance since the publication of the first edition. Thus a considerable addition is made to Chapter V, dealing with the use of liquid fuel. The later methods and appliances are discussed and the subject is brought down to the present time. Large additions are also found in the chapters dealing with the various forms of water tube boilers, as we should expect from the activity in that part of the marine field, and the prominence which this type of boiler is taking on, especially in naval practice. Some further additions are also found in the chapters dealing with attachments and accessories.

Taken as a whole this new edition maintains the high standard of excellence set by the first issue, and furnishes on the subject of marine boilers, and especially as viewed from the standpoint of French and Continental practice, the most comprehensive and extended presentation to be found.

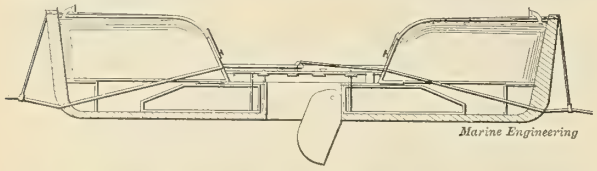
Great Changes in Power.—With its April issue *Power* appears in a new form, having been reduced to 9 by 12 inches in size. Typographically, the change is as great as from a brass stencil and blacking brush to a fine modern printing press; the result is one of the handsomest publications in the engineering field. Editorially, it gives evidence of as great a change, for broad-minded management is now very evident. *Power* is published by the Hill Publishing Company, World Building, New York. The price has been increased to $2 a year; this, however, is only 100 per cent. change, while the other changes are several hundred.

Objections to Searchlights.—Many complaints have been filed in the Treasury Department, Washington, against the temporary blinding of steamer pilots by searchlights on other vessels. These complaints are coming mostly from the Great Lakes, and are so numerous that a rule has been embodied in the steamboat regulations recently issued by the Department, as follows: "That masters, mates and pilots of all vessels be required to exercise due caution in the use of their searchlights so as not to throw the rays of light into pilothouses of passing steamers. A wilful violation of the above requirement will subject the offender to a suspension or revocation of license."

SELECTED MARINE PATENTS.

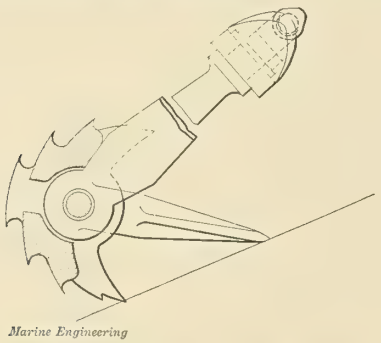
695,634. LIFE-BOAT. CHARLES DICKENSON, WASHINGTON, D. C.

Claim.—The combination with a life-boat provided with a sunken deck and hoods extending above said sunken deck, one hood at each end of said boat; each of said hoods provided with an air-tube extending above and opening outside of said hood; open shelves secured to the body of the vessel below the deck thereof in near proximity to the lower ends of said hoods; a self-acting pivot-valve; a chain provided with a ball, whereby the self-acting valves will be operative when said boat is on its bilge or when entirely inverted.



2. A life-boat comprising a hull; a sunken deck; a centerboard-well forming a self-bailing compartment in communication with said sunken deck; longitudinal bulkheads forming continuations of said centerboard-well, and forming also, part of the longitudinal bulkheads beneath said sunken deck; and fresh-water tanks located at the opposite ends of said centerboard-well; substantially as and for the purpose set forth. Four claims.

695,711. ANCHOR. JOHN EYNON, GATESHEAD, ENGLAND, assignor of two-thirds to William Summerbell Richardson, Gateshead, Durham County, England, and Edward John Williams Powell, Newcastle-upon-Tyne, England.



Claim.—1. In a tripping-anchor, a head capable of partial rotary movement relatively to the shank, and a member disposed between the flukes and provided with projections upon opposite sides of the shank forming successive trips, substantially as described.

2. In a tripping-anchor, a head capable of partial rotary movement relatively to the shank, a crown having auxiliary trips, and a member disposed between the flukes and provided with a series of projections forming successive trips, substantially as described. Four claims.

695,717. PROPELLER GEAR. GEORGE W. GARDINER, PHILADELPHIA, PA.

Claim.—1. The combination with a marine vessel having a trunk therein, of a frame mounted in the trunk and movable downward to a point below the vessel, a propeller-gear carried in the frame, and a centerboard working in the trunk independently of the said frame. Two claims.

695,758. BOAT. WILLIAM C. McELHENY, PITTSBURG, PA.

Claim.—1. The combination with an open flat-bottomed boat having external vertical sides and inclined ends, of supplemental internal side walls inclining toward the bottom and thence extending vertically to said bottom, said walls forming one continuous passage or receptacle from one end of the boat to the other. Two claims.

695,917. BOAT. AMBIEHL DOMINICK AND LOUIS KREBS, NEW YORK, N. Y.

Claim.—1. In a boat, a pair of crank-shafts combined with bent arms mounted thereon and having their ends placed at a greater distance from the boat than their center, and with blades connected to said arms and bent to form laterally-opening scoops. Two claims.

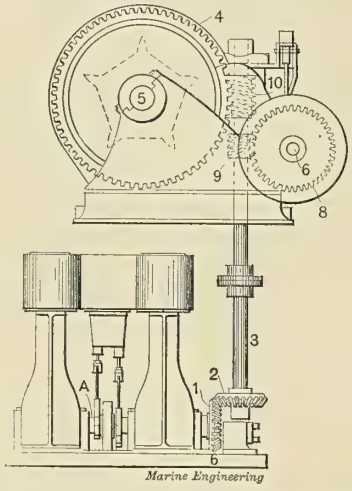
696,097. AUTOMATICALLY-PROPELLED MULTIPLE-HULL VESSEL. JAMES GRAHAM, NEW YORK, N. Y.

Claim.—1. A series of floats or hulls hinged together transversely and longitudinally and having power-generating mechanism connected therewith for propelling said floating structure.

2. A series of floats or hulls hinged together fore and aft and adapted to oscillate as they move through the water of flotation and having power-generating mechanism attached to the connecting hulls above and below the hinged points.

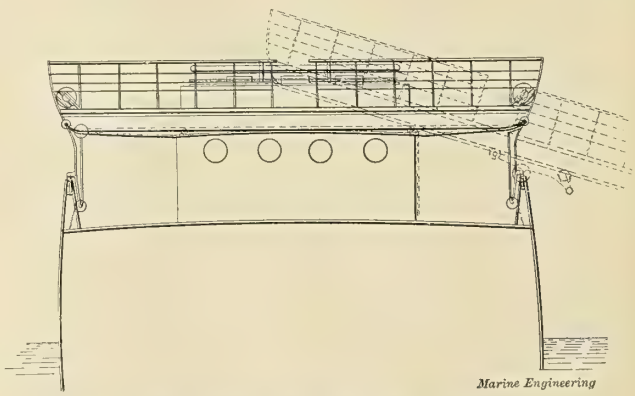
3. A series of floats or hulls hinged together side by side and adapted to rock in the water of flotation, said hinged hulls having mechanism connected therewith for generating power. Sixteen claims.

696,394. COMBINED WINDLASS AND WARPING-WINCH. JACOB R. ANDREWS, BATH, MAINE.



Claim.—In combination with the windlass and the worm-gear upon its shaft, a shaft as 3 having a worm 10 in mesh with the gear upon the windlass-shaft, a second worm 9 on the same shaft, a shaft 6 carrying winch-heads and provided with a worm-gear 8 in mesh with the second worm on the main driving shaft 3, all substantially as described. One claim.

696,463. LIFE-RAFT. DANIEL G. MARTENS, LONDON, ENGLAND.



Claim.—1. In a ship or vessel fitted with detachable floatable sections or rafts resting on the deck house or houses, means for launching the rafts, comprising raising-levers, pivoted to the deck house or houses and adapted when turned to raise and support the raft above the roof of the deck house or houses, and swinging stanchions pivoted to and turning on the taffrail or other fixed part of the vessel and carrying rollers on their extremities, said stanchions being normally held upright by powerful springs and maintained in that position by a cord or the like detachable means, substantially as described. One claim.

696,621. LIFE-BOAT, ETC. CARL E. BAARSEN, BERGEN, NORWAY.

Claim.—In combination, the curved keel, air chambers beneath the thwarts as well as in the upper part of the stem and stern, and a ballast-tank midship provided with stop-cock rod and handle, said ballast-tank being in the bottom of the boat and controlled by said stop-cock, substantially as described. One claim.

696,703. HAND-POWER PROPELLER. ISAAC A. WILSON, DETROIT, MICH.

Ship for Coronation Ceremonies.—The U. S. battleship *Illinois* has been chosen to represent the government at the coronation of King Edward VII. Admiral Crowninshield will be in command.